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THE ROCKY MOUNTAIN GOAT IN MONTANA

by

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Field Biologists

Surveys and Investigations
of Montana's Wildlife Resources
Under Federal Aid in Wildlife Restoration Act

Project 1-R

Bulletin No. 5

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TABLE OF CONTENTS

	Page
Tables	i
Illustrations	ii
Foreword	iii
Acknowledgments	iv
Introduction	1
Taxonomy	3
Habitat	4
Distinguishing Characteristics	9
Body Sizes	9
Hoofs	12
Horns	14
Weights	19
Teeth	19
Pelage	22
Glands	25
Feces	26
Sounds	26
Senses	27
Smell	27
Hearing	28
Sight	28
Life History Observations	28
Mating	28
Birth	29
Juveniles	29
Growth	30
Nursing and Feeding	30
Adults	31
Growth	31
Sexual Activity	32
Behavior and Characteristic Activities	33
Gregariousness and Group Sizes	33
Kid-adult Relationships	34
Playfulness	36
Bedding	36
Sanitation	38
Movements	40
Migrations	40
Daily	40
Seasonal	40
Reactions to People	41
Food Habits	43
Summer Food Habits	44
Winter Food Habits	46
Stomach Analyses	51
Vegetative Parts Consumed	53
Plant Species Found in Mountain Goat Habitat	55

Page

Water Requirements 58
Salt Use and Requirements 60
Numbers and Distribution in Montana 63
Historical Range and Numbers 63
Present Range and Numbers 64
Native Herds 64
Northern Continental Divide Herd 64
Glacier National Park Herd 67
Mission Range Herd 67
Whitefish Range Herd 70
Cabinet-Kootenai Herd 70
Rattlesnake Herd 70
Bitterroot Herd 71
Beaverhead Herd 71
Pioneer Mountain Herd 72
Pintlar Peaks Herd 72
Flint Creek Herd 72
Pipestone Herd 72
Introduced Herds 72
Crazy Mountains Herd 73
Beartooth Plateau Herd 73
Highwood Mountains Herd 74
Gallatin Herd 74
Decimating Factors Influencing Populations 83
Evidence of Mortality 83
Predators 85
Coyote 85
Bear 86
Mountain Lion 87
Wolverine 87
Eagle 87
Parasites and Diseases 88
Accidents 89
Management Tools and Techniques 90
Censusing 90
Preliminary Study and Census 90
Ground Rechecks of Key Areas 93
Aerial Censusing 93
Special Personal Reports 94
Live Trapping and Transplanting 95
Trapping Methods 96
Handling and Transporting 97
Harvesting 100
Summary 102
Recommendations for Management 104
Bibliography 106

TABLES

Page

1. Elevational Occurrence of Mountain Goats 5
2. Cover Type in Which Mountain Goats Were Observed 7
3. Steepness of Slope on Which Mountain Goats Were Seen 7
4. Occurrence of Mountain Goats According to Exposure 7
5. Mountain Goats From Which Body Character Data Have Been Taken. . 10
6. Body Measurements of Mountain Goats. 11
7. Hoof Measurements of Mountain Goats. 16
8. Horn Measurements of Mountain Goats. 17
9. Live Weights of Mountain Goats 20
10. Dentition of Mountain Goats. 21
11. Observed Group Sizes of Mountain Goats 33
12. Summary of Food Habits of Mountain Goats on Summer Range 45
13. Summary of Food Habits of Mountain Goats on Winter Range (Red Butte) 48
14. Summary of Food Habits of Mountain Goats on Winter Range (Rattlesnake) 49
15. Vegetative Parts of Forage Species Usually Selected by Mountain Goats. 53
16. Plants Found in and Near Mountain Goat Habitat of Western Montana 55
17. Distance of Mountain Goats From Nearest Known Water Supply When First Observed 58
18. Cumulative Mountain Goat Estimates, 1919 Through 1942. 63
19. Cumulative Mountain Goat Estimates, 1943 Through 1948. 64
20. Summary of Mountain Goat Numbers for the Northern Continental Divide Herd 65
21. Herd Composition of the Northern Continental Divide Herd 69
22. Estimated Mountain Goat Numbers and Distribution in Montana. . . 75
23. Contents of Coyote Scats Collected in Mountain Goat Habitat. . . 85
24. Time of Day Mountain Goats Were First Observed and Their Activity. 91
25. Distances From Which Mountain Goats Were First Observed. 92
26. Mountain Goats Live Trapped and Transplanted in Montana. 95
27. Mountain Goat Hunting Seasons and Kills in Montana 101

ILLUSTRATIONS

Figure — Page

1. The Chinese Wall of Sun River in Summer and in Winter. 6
2. An Adult Male Mountain Goat, Cleanly Shed. 12
3. Typical Mountain Goat Terrain. 13
4. Mountain Goats are Quite at Home on the Most Rugged Exposures of Our Mountainous Terrain 13
5. Comparison of Typical Mountain Goat, Deer and Mountain Sheep Tracks 15
6. Horns from a Male and a Female Mountain Goat 18
7. A Nanny Just Starting to Shed. 23
8. Horn Gland of Mountain Goat. 25
9. Outline of Typical Feces of Mountain Goat and Deer 26
10. A Group of Nannies and Kids in Early August. 34
11. Mountain Goat Bedded Down. 37
12. Mountain Goats Spend Much of Their Time on Remains of Snow-banks. 37
13. Dusting Bed Used Frequently by Mountain Goats. 38
14. Small Cave Known to be Used in Winter by Mountain Goats. 39
15. Fecal Deposits in a Commonly Used Bedding Site 39
16. Some Winter Mountain Goat Habitat in the Rattlesnake Drainage. . . 47
17. Use of Foliage From a Fallen Douglas Fir Tree. 50
18. Range of Northern Continental Divide Herd of Mountain Goats. . . . 66
19. Mountain Goat Distribution in Montana. 81
20. Finding a Winterkill 84
21. A Group of Mountain Goats Alerted by a Coyote. 86
22. Pen-type Trap for Capturing Mountain Goats 96
23. Mountain Goats in the Pen-type Trap. 98

FOREWORD

In 1946 a long-range study of mountain goats was started by the Wildlife Restoration Division of the Montana State Fish and Game Department. The purpose was to collect data applicable to the management of this species.

Between July 1 and October 1, 1946 a three-man crew made a detailed census of the mountain goats within the Continental Unit. Two crews of two men each were in the field during the summer of 1947. One crew studied the life histories and food habits of a herd of thirty to forty goats in the vicinity of Red Butte in the Sun River drainage. The other crew made a state-wide check of numbers and distribution. A winter food habits study was conducted in the winter of 1947-48. During 1947 and 1948 aerial censuses were made of the Bitterroots and spot ground censuses were conducted as rechecks in areas of previous studies.

Most of the study centered around the large herd within the Continental Unit. This unit includes the South Fork and Middle Fork of Flathead River and the headwaters of the Sun River and the Teton River. It lies from Glacier National Park south for about 100 miles along the Continental Divide. Other work was done in the Rattlesnake drainage just north of Missoula. The state-wide check included all goat habitat within the state, which is principally the most rugged portion of the western half of the state.

All three authors have participated extensively in the field work of this study, but each individual has been charged with reporting on one particular phase. The report on census and distribution has been prepared and submitted by Merle J. Rognrud. Life history, behavior and characteristics have been reported by Stewart M. Brandborg. A report on food habits has been submitted by Robert L. Casebeer. The complete reports of these phases are on file with the Wildlife Restoration Division of the Montana Fish and Game Department. It has been the responsibility of the latter author to assemble all materials into this report.

This writing does not conclude the mountain goat investigation in Montana. Various phases are being continued in an effort to manage this big game species for its highest possible aesthetic and sporting value to the people of Montana.

Robert L. Casebeer
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Department

ACKNOWLEDGMENTS

The authors have received splendid cooperation from many individuals too numerous to list individually. The following acknowledgments are made for their interest and assistance in carrying out this study and preparing this report.

The United States Forest Service has generously cooperated by furnishing quarters for personnel of this study. Many individuals of that Service have given valuable assistance in planning and executing the study. Personnel of the Glacier National Park Service have contributed information about the goats in the Park and as help for planning this study. Faculty members in the School of Forestry and the Biological Science Department of Montana State University have given invaluable aid. Deputy Game Wardens, licensed guides and outfitters, and many private individuals have generously contributed valuable information.

This study has been under the supervision of the State Game Warden and the Director of the Wildlife Restoration Division for the State of Montana. Many employees of the Wildlife Restoration Division have participated in this study and their sincere interest is greatly appreciated. All photographs have been taken by personnel of this Division.

Editorial assistance contributed by Lowell Adams, Biologist for the United States Fish and Wildlife Service, has been valuable in the completion of this report.

THE ROCKY MOUNTAIN GOAT IN MONTANA

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INTRODUCTION

Mountain goat range is so remote and its habitat so forbidding that during the early explorations of the Northwest this animal was considered a hunter's myth by many authorities, and at least a rare species by others. Early information relevant to its range and habits trickled in slowly, making no sudden entry as one single and complete picture. Bits of the earliest information came from the writings of the pioneering explorers and fur traders of northwestern United States.

Throughout their entire trip of 1805-06, Lewis and Clark had few encounters with the white "mountain sheep", but their journal entry of April 10, 1806, from the Cascades, is usually considered the basis for the scientific description and name (Seton, 1929). M.H.D. deBlainville described the animal in 1816, naming it Rupicapra americana, but added nothing more to its life history than the description by Lewis and Clark.

On February 9, 1811, Alexander Henry described an episode at Kootenay Park on the Great Divide near the national boundary, in which he and his guide attempted to kill a "white goat" (Coues, 1897).

Richard Harlan (1825) published a letter from Major Stephen H. Long in which Long, who had recently returned from the far west, gives the earliest known attempt at a history of the mountain goat. Harlan was the first to call this animal the "Rocky Mountain goat". The account given to Harlan was hearsay from the Hudson's Bay Company people at Fort Garry (now Winnipeg).

Dr. J. C. Merrill, an army surgeon at Missoula, Montana, sent to Professor S. F. Baird an accurate article on the habits of the animal in 1879. This was published by the National Museum (Merrill, 1880) and definitely registered this species as the Rocky Mountain goat in the fauna of the United States.

An article by Baillie-Grohman (1884) reports that "For three consecutive years, I hunted on the breezy mountain ranges of Wyoming, Colorado, Idaho, and eastern Montana, living for months at altitudes over 10,000 feet; but I failed utterly to find this mysterious game elsewhere than in the conversation of romancing trappers and guides; a circumstance that created in my mind a decided tendency to look upon all 'goat' stories with a good deal of suspicious reserve. * * * I determined that my next annual visit to the Far West was to be exclusively devoted to goat hunting; and a letter I received in May, 1882, from a reliable friend and countryman residing in Western Montana, declaring that he had actually seen, not alive, but what was next best, a dead mountain goat made me pack my trunks and engage passage in hot haste." By satisfying himself that the white goat

of the mountains was no myth, Baillie-Grohman was the first known pioneer of many an avid sportsman who has since stalked this big game animal with binoculars, camera and gun.

In recent years the mountain goat in western Montana has been recognized as an important part of our big game fauna and is frequently used to symbolize the aesthetic values of our wildlife and recreational resources. It has been adopted by Glacier National Park, in northwest Montana, to symbolize the outstanding native fauna species being preserved therein. The silhouette of a mountain goat emblemizes the Great Northern Railroad on all its rolling stock and literature.

This species was recognized as one of the valuable big game species in Montana during the earliest considerations of conservation. Restrictions on the hunting or killing of goats were made as early as 1905. At that time a regulation was enacted to limit each hunter to only one goat, of either sex, from anywhere in the state between September 1 and December 1. Later it was felt that goat numbers were not great enough to continue this statewide hunting. The entire state was then closed to the hunting of goats. Individual areas, the Bitterroots and the South Fork of the Flathead, were later opened independently for small annual harvests.

Good conservation practice now requires action beyond the mere limitations of hunter takes. Aesthetic and sporting demands can best be met only by the restoration and maintenance of goat numbers commensurable to the fullest capacity of their habitat. To accomplish this, many questions must be answered. What is the status of the mountain goat numbers, range and distribution? What are the principal features in their life history limiting their numbers and distribution? How can management be applied to increase or stabilize numbers? And to what extent can continued or additional harvest by hunting be allowed?

Such questions cannot be answered in a single investigation, nor in so short a time as has been incorporated in the studies to date. Some will be answered here, at least in part. This study has been designed to present an inventory of the numbers, life history data and management practices as they are now known, to serve as a basis for developing the standard of management desirable in the future.

TAXONOMY

Oreamnos americanus missoulae Allen

1/

Ovis montanus Ord, Guthrie's Geol., 2d Amer. Ed., p 292, 1815 (preoccupied).

R(upicapra). americana Blainville, Bull. Sci. Soc. Philomath, Paris p. 80, 1816.

Mazama dorsata Rafinesque, Amer. Month. Mag., 2:44, 1817 (new name for Ovis montanus Ord).

Mazama montana True, Proc. U. S. Nat. Mus., 7 (1884):592, 1885.

Oreamnos montanus Merriam, Science, N. S., 1:19, 1895.

Oreamnos montanus missoulae Allen, Bull. Amer. Mus. Nat. Hist., 20:20, February 10, 1904.

Oreamnos americanus missoulae Hollister, Proc. Biol. Soc. Washington, 25:186, December 24, 1912.

Type obtained at Missoula, Missoula County, Montana the type specimen is in the American Museum of Natural History.

The generic name is from the Greek, oreos, of a mountain, and amnos, a lamb. The species name is from Latin, americanus, of America; and the subspecies, missoulae, taken from the location from which the type specimen was taken, Missoula, Montana.

Many common names have been used to designate this animal. The more common ones are: white goat, Rock Mountain goat, American chamois, goat-antelope, antelope-goat, wool-bearing antelope, white buffalo, white antelope and mazama.

This species belongs to the family Bovidae, and the subfamily Rupicaprinae. It is the only living member of the genus Oreamnos. Its nearest relatives are the forest-goats or goat-antelopes of Asia, namely the serow of Japan and the goral of the Himalayas, also the chamois of the European mountains.

1/ Synonymy taken from Dalquest, 1948.

HABITAT

The western portion of Montana where goats are found is marked by well-defined drainage systems composed of deep valleys 2,000 to 4,000 feet in elevation and mountains 9,000 to 11,000 feet in elevation. Usually these elevational differences occur within short horizontal distances. This is obvious from the many steep canyon walls, high rocky reefs and the many jagged outcroppings of rock.

Many wide glaciated valleys of high fertility are now disposed to development by civilization and form definite barriers to migration and further natural expansion of mountain goat range. Movements of these animals are mostly within the upper limits of drainage headwaters, the drainage divides and especially the Continental Divide.

Climatic conditions in the mountains are highly variable, both generally and locally. Extremes in temperatures and moisture conditions are quite evident between day and night and between the seasons of the year. Mountain temperatures of 80 to 100 degrees are common during the days of summer months. They drop to between 30 and 50 degrees at night. In winter 20 to 40 degrees below zero is common at night, but daytime temperatures go up to 10 or 20 above zero. Temperatures during the spring and fall also fluctuate greatly. They are usually accompanied by the rainy seasons which enhances the severity of the cold. The spring and fall rainfall averages between one and four inches per month. During the summer, especially July and August, precipitation is usually less than one-half inch per month. Most precipitation within the mountain region occurs in the form of snow. The amount and depth varies greatly according to place, altitude, exposure and wind. At higher elevations westerly winds are almost constant and strong. These winds have great local effect on climate and forage conditions or range availability.

Stands of coniferous trees represent the vegetation of most mountainous areas. These are interspersed with open ridges, hills and valley bottoms of bunchgrass or browse.

Areas typifying mountain goat habitat in Montana are usually found within the upper Hudsonian and the Arctic-Alpine life zones described by Bailey (1918) in Glacier National Park.

The Hudsonian zone commonly occurs as a narrow belt between 6,000 and 7,000 feet elevation on the cooler and more moist north and east exposures and between 7,000 and 8,000 feet on the warmer and drier south and west exposures. Its borders are quite irregular. The lower edge merges into the solid Canadian zone forest while the upper edge is marked by finger-tips of dwarfed or prostrate trees.

Above the Hudsonian, the Arctic-Alpine zone caps the high peaks. It is characterized by live glaciers, large snowfields, great expanses of barren cliffs and rocks and extensive areas of depauperate vegetation.

The south and west exposures within the Hudsonian zone furnish most of the spring and early summer goat feed as these sites are the first exposed

by the sun and prevailing westerly winds. But as these areas lose their moisture, the summer aspect changes to one of more zerophytic plants of lower desirability. This causes the animals to seek more succulent growth in other areas for late summer use.

During the winter in this high mountainous country prevailing westerly winds build up pronounced snow cornices on the leeward side of the ridges and within the easterly-exposed cirques. Such a cornice lasts till late in the summer and contributes a continual water supply to the slopes below throughout the summer and usually into the fall. On these slopes the more luxuriant summer and fall feeds occur and are used extensively by mountain goats.

In winter most goats remain on the same ranges that are used in the summer and take advantage of the exposed vegetation on the bald, wind-swept ridges. Some summer ranges are not subjected to the clearing action by the wind during the winter and the animals must migrate to lower altitudes. There the goats seek cliffs and ledges with warm south exposures which offer available vegetation and the type of protection they enjoy on their rugged summer ranges.

During the preliminary goat study conducted in the Continental Divide Unit during 1946, information was gathered relative to habitat distribution. For each goat observed, a record was made of its location and the habitat conditions, such as elevation, cover type, steepness of slope and exposure in which it occurred.

More than 96 per cent of the goats seen were in the open alpine areas above timber line. Data in Table 1 show that most all animals were seen above 6,750 feet and up to 8,250 feet. Lack of extensive territory above the latter altitude restricted distribution above that level.

TABLE 1

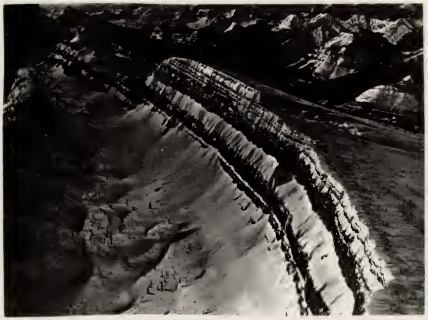
ELEVATIONAL OCCURRENCE OF MOUNTAIN GOATS
(Flathead-Sun River, July through September, 1946)

Elevation (ft. above sea level)	Adults Unclass-ified	Mature Males	Mature Females	Year-lings	Kids	Unclass-ified	Per Cent	Totals
5250-5750	1		1		1		1	3
5750-6250		2					1	2
6250-6750		3		3			2	6
6750-7250	36	17	13	3	14	11	28	94
7250-7750	35	25	14	8	12	4	29	98
7750-8250	46	13	25	22	19	5	38	130
8250-8750	4						1	4
Totals	122	60	53	36	46	20	100	337

Coniferous forest is the predominant cover type below 7,000 feet. Poorer visibility in the timber may have resulted in seeing and reporting fewer goats than actually occurred there. However, evidence presented in Table 2 regarding cover type in which the animals were found indicates

Summer

Figure I. Chinese Wall



Winter

that a fair proportion, 15 per cent of all animals, were observed within timber.

TABLE 2

COVER TYPE IN WHICH MOUNTAIN GOATS WERE OBSERVED
(Flathead-Sun River, Summer, 1946)

	Timber	Alpine openings with Browse & Herbs	Broken Cliffs	Slide Rock	Barren	Total
Number seen	52	130	80	55	20	337
Per cent	15	39	24	16	6	100

The above table indicates that most goats were seen where food was most abundant above timber line. Some were seen on barren areas and slide rock.

The data in Table 3 corroborates the statement that goats are usually found in rugged habitat.

TABLE 3

STEEPNESS OF SLOPE ON WHICH MOUNTAIN GOATS WERE SEEN
(Flathead-Sun River, Summer, 1946)

	Level	Gentle	Moderate	Steep	Cliffs	Total
Number seen	8	17	94	97	121	337
Per cent	2	5	28	29	36	100

It is evident that the steeper the slope, the greater the occurrence of mountain goats. With their well-developed adaptations for negotiating rugged mountain terrain, mountain goats may retreat to cliffs and ledges as shelter against predators. In most cases where they were seen on moderate or gentle slopes, cliffs and ledges were near by.

Data as to exposure on which the animals were first observed are summarized in Table 4.

TABLE 4

OCCURRENCE OF MOUNTAIN GOATS ACCORDING TO EXPOSURE
(Flathead-Sun River, Summer, 1946)

	N	NE	E	SE	S	SW	W	NW	Total
Number of goats	23	45	70	75	25	35	43	21	337
Per cent	7	13	21	22	7	11	13	6	100

There is apparently only little specific selection of exposure by goats during the summer. The tendency for a greater number having occurred on eastern exposures, results from local topography. In this Continental Divide region the mountain chains run mostly north and south, forming mostly east and west exposures. The geologic formation of the Flathead-Sun River range is such that the eastern exposures are composed of extensive cliffs and ledges. The west exposures are usually slopes varying from gentle to very steep. Thus the typical goat habitat occurs most frequently on eastern exposures.

DISTINGUISHING CHARACTERISTICS

Data presented in this report relevant to body characteristics were obtained from animals killed by hunters or winterkilled, and from animals captured alive during live trapping and transplanting operations. Thus far no animals have been taken under special permit for this study. From the incomplete sets of data presented here, it is evident that special measures may have to be taken to secure necessary data for describing those age or sex groups for which data are lacking. Information has been gathered from 29 animals and is presented here for consideration in identifying the Rocky Mountain goat of Montana. Each animal from which data were obtained is listed in Table 5 and is designated by a number. These numbers are used throughout the tables and text to identify the same specific animals in all instances.

There is no direct proof as to the ages of any animals listed here, except animal numbered "1". Through the discussion that follows, we will try to substantiate the estimated ages listed in Table 5 by comparisons of the various body sizes, tooth succession and the date the animal was observed or killed in relation to the normal date for birth. Segregation of age groups has been made by classifying all animals thought to be from 9 to 17 months as yearlings and those of 23 or 24 months as two-year olds. It is believed that animals numbered "12" through "17" are three-year olds, and animal numbered "18" is a four-year old. Some of the animals numbered from "19" to "29" may also belong to the three and four-year old age groups but there are insufficient data available to classify them as such.

Body Sizes

Standard body measurements were made of 22 goats (Table 6).

Kids were about 14 inches high at the shoulders when born. Until they were four to six weeks of age they were often seen to walk beneath the mother animals, either during nursing or playing. After mid-July, height growth of kids prohibited this any longer, at least with any amount of ease.

Little difference in body sizes of the male and female yearlings was apparent. Female numbered "3" and males numbered "4" and "5" were of comparable age. The female was an inch and a half longer in body length but the height at shoulder measurements was the same.

Comparisons of two-year olds, showed female numbered "9" to have had a body length of 3½ to 4 inches longer than males numbered "10" and "11". The female also excelled by 1½ inches in tail length, ½ inch in ear length and 2½ to 8 inches in height at the shoulders.

Body measurements indicated little difference between the sizes of three-year old males and females, except the males were taller in the shoulders by 1½ to 3½ inches.

Body size differences between the sexes became more noticeable in the adult animals. Males averaged about 5 inches greater in length and 4½ inches higher at the shoulders than females. This shoulder height difference was

TABLE 5

MOUNTAIN GOATS FROM WHICH BODY CHARACTER DATA HAVE BEEN TAKEN

Animal Number	Estimated Age	Sex	Date Collected	Where Collected	Weight	Body Meas.	Horn Meas.	Tooth Succession	Remarks
Kid 1	Birth	M	June 13, 1949	Salmon Licks, S. Fork Flathead	#	#	#	#	Born dead
Yearling									
2	9 mos.	?	June 8, 1948	Hermit Lake, W. Fk. Sun River			#	#	Winterkill
3	12 mos.	F	May 21, 1948	Deep Creek, Teton Co.	#	#	#	#	Live trapped
4	11 mos.	M	May 6, 1947	Deep Creek, Teton Co.	#	#	#	#	Live trapped
5	12 mos.	M	May 21, 1948	Deep Creek, Teton Co.	#	#	#	#	Live trapped
Long Yearling									
6	17 mos.	F	Oct. 15, 1947	Crimson Peak, S. Fork, Flathead		#	#	#	Hunter kill
7	17 mos.	M	Oct. 15, 1947	Kid Mt.,S. Fk. Flathead			#	#	Hunter kill
Two-year Olds									
8	23 mos.	F	May 9, 1947	Deep Cr., Teton County			#	#	Killed in trap
9	23 mos.	F	May 6, 1947	Deep Cr., Teton County	#	#	#	#	Live trapped
10	24 mos.	M	May 21, 1948	Deep Cr., Teton County	#	#	#	#	Live trapped
11	24 mos.	M	May 21, 1948	Deep Cr., Teton County	#	#	#		Live trapped
12	32-34 mos.	?	May, 1948	Indian Cr.W.Fk.Sun River			#	#	Winterkill
13	35 mos.	F	May 3, 1948	Deep Cr., Teton County			#	#	Killed in trap
14	35 mos.	F	May 6, 1947	Deep Cr., Teton County	#	#	#	#	Live trapped
15	35 mos.	F	May 6, 1947	Deep Cr., Teton County	#	#	#	#	Live trapped
16	35 mos.	M	May 6, 1947	Deep Cr., Teton County	#	#	#	#	Live trapped
17	35 mos.	M	May 8, 1948	Deep Cr., Teton County	#	#	#	#	Killed in trap
18	47 mos.	M	May 6, 1947	Deep Cr., Teton County	#	#	#	#	Live trapped
Adults									
19	Adult	F	Oct. 20, 1947	Kid Mt.,S.Fk. Flathead		#	#	#	Hunter kill
20	Adult	F	May 21, 1948	Deep Cr., Teton County	#	#	#		Live trapped
21	Adult	F	May 21, 1948	Deep cr., Teton County	#	#	#		Live trapped
22	Adult	F	Oct. 15, 1947	Crimson Peak,S.Fk.Flathead		#	#	#	Hunter kill
23	Adult	F	Jan. 15, 1948	Rattlesnake Cr.,Msla.Co.	#	#	#	#	Winterkill
24	Adult	M	May 18, 1948	Deep Cr., Teton County	#	#	#		Live trapped
25	Adult	M	May 6, 1948	Deep Cr., Teton County	#	#	#		Live trapped
26	Adult	M	May 18, 1948	Deep Cr., Teton County	#	#	#		Live trapped
27	Adult	M	May 18, 1948	Deep Cr., Teton County	#	#	#		Live trapped
28	Adult	F	May, 1948	Deep Cr., Teton County			#	#	Winterkill
29	Adult	M	May 6, 1948	Deep Cr., Teton County			#	#	Killed in trap

# Denotes that this information was obtained and is presented later in table or text form.

TABLE 6

BODY MEASUREMENTS OF MOUNTAIN GOATS
(In inches)

Animal Number	Sex	Total Length	Tail Length	Length of Hind Foot	Ear Length	Height at Shoulders
Kid						
1	M	21.5		7	2.5	14
Yearling						
3	F	39	3	10	4.25	24
4	M	37.5	2.25	10.25	4.5	24
5	M	37.5	3.5	10.5	4	25
Long Yearling						
6	F	41	4	11	4.5	27
Two-year Olds						
9	F	46	4	11.5	4.5	32.5
10	M	42	2.5	10.5	3.25	24.5
11	M	42.5	2.75	11.5	4	30
Three-year Olds						
14	F	54	4.5	12.5	4.75	33.5
15	F	53	5	12.5	4.5	32.25
16	M	54.5	5	13	5	36
17	M	49	3.25	11.75	4.75	35
Adults (over two years old)*						
18	M	60	5	13	5	35.5
19	F	55	3.5	11	4.5	33.5
20	F	56		10	4.75	34.5
21	F	61	4	12.5		35
22	F	53	5.5	12	5	36
23	F	54	4	10	4.5	31.5
24	M	65.5	3.5	13.5	5	39
25	M	61	4.75	13.5	5.5	43.5
26	M	58.5	3.5	13.5	5.5	37.5
27	M	57.5	3.5	12.75		37
			AVERAGES			
Yearlings						
	M	37.5	2.87	10.37	4.25	24.5
	F	39	3	10	4.25	24
Two-year Olds						
	M	42.25	2.67	11	3.67	27.25
	F	46	4	11.5	4.5	32.5
Adults						
	M	60.5	4	13.25	5.25	38.5
	F	56	4.2	11	4.7	34

* Animals unclassified as to age but known to be over two years old.

Figure 2

An Adult Male Mountain Goat, Cleanly Shed

associated with the slightly bulkier build of the males' front quarters. Just after shedding, at the time the pelage of the new coat was still short, a large billy could sometimes be identified at close range by his more massive front quarters. His front quarters seemed to be built in slightly larger proportions than his hindquarters with greater depth through the chest region. His front legs appeared short but quite stocky. This feature could not be relied upon for field identification except in case of some of the larger billies when seen at reasonably close range.

Hoofs

The construction of mountain goat hoofs is one adaptive anatomical feature which allows this animal to out-maneuver most other hoofed mammals in steep rocky terrain. Instead of a concave sole within the horny walls of each digit of the hoof, as in most bovine animals, the mountain goat has a heavy sponge-like convex pad protruding outside the horny walls. This affords traction on solid surfaces and facilitates the goats' maneuverability much the same as rubber-soled shoes aid man in walking.

Under favorable soil or snow conditions the concave depression left by the pad helped to distinguish between deer and mountain goat tracks. Other differences, however, were usually more apparent for field identification and could be used quite successfully after a little practice. Figure 5 illustrates the outline of mountain goat, deer and mountain sheep tracks. The two digits on each hoof of a normally walking goat are nearly parallel to each other. Each digit is about the same width along its entire length. A blunt point on the forward end distinguishes it from the more rounded back end. The

Figure 3

Figure 4

Steep, rocky slopes were frequently traversed by goat.
No perceptible ledges were found on this face.

outside lines of the hoof are nearly straight and parallel, without the slight indentation in the outside edge common to mountain sheep tracks and lacking the heart-shaped appearance of deer tracks.

Most hoofs were a quarter to a half inch longer than wide, except for some large billies such as those numbered "24", "26" and "27" in Table 7. In the latter the proportions were practically square. According to measurements in this same table the front hoofs were always larger than the back hoofs by a quarter to a half an inch for each dimension.

The average size of mountain goat hoofs or tracks were: Yearlings of either sex, 2 by 1.5 inches for the front feet and 1.75 by 1.5 inches for the back feet. Adult females, 2.5 by 2.25 inches for the front feet and 2.25 by 2 inches for the hind feet; and adult males, 2.75 by 2.5 inches for the front feet and 2.5 by 2.25 inches for the hind feet. Mountain sheep and mule deer are the only species apt to be found in the same environment whose tracks range about these sizes. Characteristics mentioned previously will help to distinguish the tracks of those species.

Horns

The short, slightly recurved and dagger-like black horns of the mountain goat are bovine in structure, being hollow caps on persistent bony cores. Both the horn and the core grow larger each year. The horn is never shed.

On each horn there occurs a series of rings as shown in Figure 6. Except for the outermost ring, most rings are usually prominent and easily identified. It is suspicioned that these rings are annual growth rings and for the first few years of a goat's life may be used for determining its age. A specific study is needed to obtain data which will support or disprove this theory.

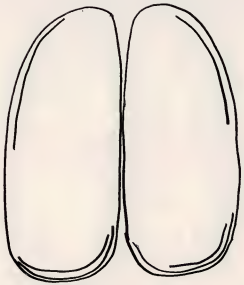
Apparently most of the length in horn growth occurs within the first eighteen months.

Leathery black spots about the size of a dime occurred on a newborn kid's head at the site of the horns. These were raised slightly by a sharp point of bone about 1/32 of an inch high occurring on the skull. The black spots could not be seen in the field until in July, when the animals were from 4 to 6 weeks old and the spots had increased to a more obvious size. The earliest true horn development noticed in the field was observed on August 24th, when a kid with horns about 1/2 inch long was seen in the Red Butte area.

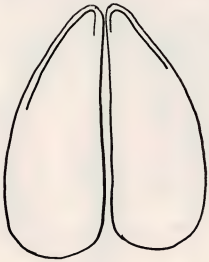
A kid, numbered "2", found dead, was thought to be about 9 months of age when it died. This animal had horns 1.87 inches long. Yearling animals numbered "3", "4" and "5", in Table 8, had horns 3.25 to 4.25 inches long. Two long yearlings, numbered "6" and "7", were taken in the fall at the age of approximately 17 months and had horns 6 to 6.25 inches long, indicating a growth of 2 to 3 inches during their second summer season. Animals numbered "8", "9", "10" and "11", taken in the spring when 2 years old, had horns about that same length, indicating little or no growth during the second winter. At that age, the length was 5.5 to 6.5 inches. Growth after

Figure 5

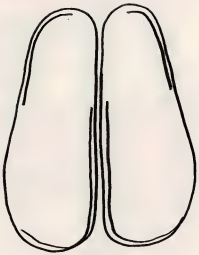
Comparison of Mountain Goat, Deer and Mountain Sheep Tracks



Mountain Goat



Deer



Mountain Sheep

TABLE 7

HOOF MEASUREMENTS OF MOUNTAIN GOATS 1/
(In inches)

Animal Number	Sex	Front Hoofs		Back Hoofs	
		Length	Width	Length	Width
Kids					
1	M	1.25	.87	1.00	.87
Yearlings					
3	F	2.00	1.50	1.75	1.50
5	M	2.00	1.50	1.75	1.50
Long Yearlings					
6	F	2.13	1.75	2.00	1.63
Two-year Olds					
10	M	2.00	1.75	1.75	1.50
11	M	2.50	2.00	2.00	1.75
Adults					
17	M	2.50	1.87	2.25	1.75
19	F	2.63	2.37	2.25	2.00
20	F	2.50	2.13	2.50	1.87
21	F	2.50	2.25	2.37	2.00
22	F	2.75	2.50	2.50	2.00
23	F	2.75	2.25	2.50	2.25
24	M	2.75	2.75	2.50	2.37
25	M	2.87	2.50	2.87	2.13
26	M	2.75	2.75	2.50	2.00
27	M	2.25	2.25	2.00	1.87

1/ All measurements are the outside lengths and widths on the bottom surface of the hoofs. The length is the longest distance from the toe to the heel of the hoof parallel with digits, and the width is the distance at the widest portion across both digits taken vertically to the length measurement.

TABLE 8

HORN MEASUREMENTS OF MOUNTAIN GOATS
(In inches)

Animal Number	Sex	Length on Front Curve	Spread	Tip-to-Tip	Circumference at Base
Yearlings					
2	?	1.87			1.75
3	F	3.25	2.75	2.75	2.5
4	M	3.5	3.25	3.25	2.75
5	M	4.25	3.37	3.37	3
Long Yearlings					
6	F	6	3.87	3.87	3
7	M	6.25	4.75	4.5	4.25
Two-year Olds					
8	F	5.75	4.13		3.25
9	F	6	4.25	4.25	3
10	M	5.5	3.5	3.25	3.25
11	M	6.5	3.87	3.87	4.13
Three-year Olds					
12	?	6.87			3.5
13	F	6.63			3.63
14	F	7.5	6	6	4
15	F	7.75	4.25	3.5	3.75
16	M	8	5.5	5.5	4.5
17	M	8.25	4.37	3.87	4.38
Other Adults					
18	M	8	5.5	5.25	5
19	F	9	6.25	6.25	3.87
20	F		5.25	4	4
21	F	8.5	6.25	6.25	4.5
22	F	8.5	4.87	4.5	4
23	F	8.5			3.75
24	M	9.5	6	6	5.25
25	M	10	5.75	5	5.5
26	M	9	6.25	6	5.25
27	M	9.25	6.63	6.63	4.75
28	F	7.25	6.37		3.5
29	M	9.5	5.87	4.63	5.25

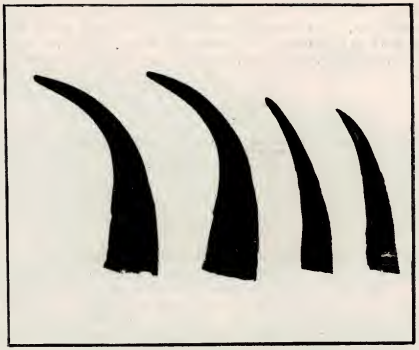


Figure 6

Horns From a Male and a Female Mountain Goat

the second year was at a slower rate for they would seldom add 4 inches more during the rest of their life.

Both sexes had horns of about equal length. Sexual differences could often be distinguished in the adult stage by the degree of curve from the base to the tip and the difference in the circumference at the base.

In many instances, the horns of male goats had more of a curve than those of females. Figure 6 illustrates this difference in horns from animals of opposite sexes, but of approximately the same age. This characteristic was not always so marked and was considered weak for field identification purposes.

Table 8 shows the close similarities in total horn length for the two sexes within the same age groups. However, most all trophies listed by the Boone and Crockett Club (Anonymous, 1939) were over 10 inches in length and most of them were from males. Those lengths over 9 inches in Table 8 were also all from males.

Table 8 does indicate a close similarity in the spread and in the tip-to-tip measurements of the two sexes.

The basal circumference was consistently greater for adult male animals than it was for adult females. This difference is also illustrated in Figure 6. The smallest circumferences measured of adult male horns was 4.37 inches and others ranged up to 5.25 inches. Four and a half inches was the largest circumference measured for any adult female's horns. Use of this characteristic for field identification of sex was possible only

under ideal conditions. The observer had to be at close range and had to have the aid of good binoculars or a spotting scope. He must also have been thoroughly familiar with the perceptible variation in horn size that he would encounter.

Weights

Our local subspecies missoulae is described by Anthony (1928) as the smallest of four subspecies of Oreamnos americana. According to O'Conner (1947) it is not uncommon in northern British Columbia and Alaska to kill large billies weighing 250 to 300 pounds, and occasionally more. However, goats taken in Montana are exceptional if they weigh over 200 pounds, as indicated by a number of live weights listed in Table 9.

The only weight obtained of a kid was the male, numbered "1", which weighed 8½ pounds at birth. The kid was born dead so no subsequent weights could be taken. Anderson (1940), working on a different subspecies of goats in Washington, reports that a female and a male captured on June 1st and 2nd, then probably not more than one to two weeks old weighed 6 and 8 pounds respectively. The male outweighed the female by two pounds. It is possible kids lose some weight during their first week or two.

There has been no segregation of one and two-year old animals in Table 9 because of lack of additional information for all animals from which weights were taken. However, animals numbered "3", "4" and "5" were estimated to be yearlings of 11 or 12 months old and animals numbered "9", "10" and "11" were estimated to be 2 years old when the weights were taken.

There was little or no difference in weights between sexes of yearlings or sexes of two-year olds. Yearling weights ranged between 40 and 50 pounds and two-year olds from 57 to 67 pounds, an increase of 15 to 25 pounds in the second year.

Sexual differentiation in body weights began to be more marked after the second year. An average of the adult weights shown in Table 9 indicates that males averaged 7 to 8 per cent heavier than females and the heavier animals were most always males. There were 3 males listed which weighed from 7 to 36 pounds more than the heaviest female. The range of adult weights recorded was 101 to 158 pounds for the females with an average of 126 pounds, and 102 to 194 pounds for males with an average of 135 pounds.

Some variability in the weights listed here may be attributed to the fact that some animals were weighed in the spring and some in the fall. This reflects some seasonal fluctuations of physical condition. The billy, numbered "24", weighed 194 pounds on May 18, 1948. If this animal had been weighed the previous fall it would most likely have exceeded 200 pounds.

Teeth

The dental formula of a normally developed mature mountain goat is:

Incisors $\frac{0-0}{4-4}$ Canines $\frac{0-0}{0-0}$ Premolars $\frac{3-3}{3-3}$ Molars $\frac{3-3}{3-3} = 32$

TABLE 9

LIVE WEIGHTS OF MOUNTAIN GOATS
(in pounds)

One and Two-year Olds				Adults (over two years old)			
Females		Males		Females		Males	
Animal Number	Weight	Animal Number	Weight	Animal Number	Weight	Animal Number	Weight
3	42			14	110	16	102
9	62	1	8.5	15	101	17	60
1/	37	4	45	20	117	18	146
	40	5	43	21	107	24	194
	41	10	57	23	67	25	165
	47	11	67	1/	104	26	143
	48	1/	42		115	27	124
	48		50		122	1/	102
	49		55		135		104
	52		60		141		112
	56		90		144		128
	68				152		130
	72				158		170
	75						
	84						
	88						
Range	37-88		43-90		101-185 2/		102-194 2/
Average	57		57		126 2/		135 2/

1/ The weights for which there are no assigned animal numbers were from goats live trapped for transplanting before the detailed records were kept.

2/ The weights of one female and one male were disregarded because they were from subnormal animals which died of malnutrition.

TABLE 10

DENTITION OF MOUNTAIN GOATS

Animal Number	Sex	Estimated Age	Incisors	Premolars	Molars
1	M	Birth	Three pair milk	Three pair milk	None showing
2	?	9 months	All milk	All milk	One pair through gums
3	F	12 "	All milk	*	*
4	M	11 "	All milk	*	*
5	M	12 "	All milk	*	*
6	F	17 "	One pair permanent one of second pair half-grown, other five teeh milk	All milk	Two pair developed, third pair just breaking mandible
7	M	17 "	One pair permanent, three pair milk	All milk	Two pair developed, third pair a third developed.
8	F	23 "	One pair permanent,three pair milk	All milk	Two pair developed
9	F	23 "	One pair permanent, three pair milk	*	*
10	M	24 "	One pair permanent	*	*
12	?	33 or 34 mo.	Two pair permanent, two pair milk	Two pair permanent, one pair milk	Two pair developed, one pair third to half developed
13	F	35 mo.	Two pair permanent, two pair milk	All permanent	All developed.
14	F	35 "	Two pair permanent, two pair milk	*	*
15	F	35 "	Two pair permanent, two pair milk	*	*
16	M	35 "	Two pair permanent,two pair milk	*	*
17	M	35 "	Two pair permanent,two pair milk	All permanent	Two pair developed, third pair partisly through gums
18	M	47 "	Three pair permanent, one pair milk	*	*

* These were live animals and only incisors could be examined.

At the time of birth, one kid goat, numbered "1", had three pairs of milk incisors showing. Three pairs of milk premolars showed in both jaws. The front premolar in the lower jaw was single-cusped, the second two-cusped and the third three-cusped. All upper premolars were two-cusped. The first set of molars was present in the lower jawbone but not showing above the gums. No other molars in the lower jaw and no molars in the upper jaw were present. All the teeth in this newly born animal were totally covered with a membranous layer of skin.

Animal numbered "2" was approximately 9 months old when it died. It had four pairs of milk incisors in the lower jaw and three pairs of milk premolars in each jaw. It also had the first pair of molars. According to the records shown in Table 10, the animals retained these teeth until after they were twelve months old. By the time they were seventeen months of age the innermost pair of incisors were replaced by permanent teeth, another pair of molars developed through the gums and the third pair of molars broke through the mandibles. This complement was kept until after the animals were two years old. Between 24 and 33 months of age the second pair of incisors were replaced by permanent incisors, and two pairs of premolars were replaced by permanent teeth. Within the next two or three months the third pair of premolars were replaced and the third pair of molars were at least partially through the gums.

It was thought that Number 17 was a four-year old, since it had one more pair of permanent incisors than six other animals examined at the same time of the year. This evidence was not fully substantiating, but correlation with the body measurements gives further indication that the aging given was probably correct. If so, the animals got their third set of permanent incisors between the ages of three and four years and their fourth set some time after becoming four years old.

The first permanent premolars in the lower jaw were one-cusped. Both the second and third premolars were two-cusped. This was a change in the third premolar from three-cusped milk teeth to two-cusped permanent teeth. This type of change occurred only in the lower jaw.

At least two pairs of molars were developed for some time before the permanent premolars came in. The premolars were all replaced within a relatively short period of time. They seemed to receive heavy use once they were in, as they lost their sharp enamel ridges before the molars did.

Pelage

The Rocky Mountain goat is the only big game species in the United States with an all white coat. It stands out most conspicuously against the colored backdrops of summer, but melts easily into the snowy background of winter. During the summer the new coat of this white fleece has little discoloration and is in sharp contrast to the animals' black horns, lips, nose and hoofs and brown eyes. Seton (1929) reports that many mountain goat pelts contain a scattering of brown hairs along the back or around the rump and tail region. No such coloration has been noticed on Montana goats any time during this study.

Each spring, from the time a goat is a year old, it sheds and sloughs

Figure 7

A Nanny Just Starting to Shed

off its long winter pelage, leaving a white and fleecy short-haired coat. During the summer and fall this new hair grows into the long protective cover needed against the winter elements. The earliest evidence of shedding was noticed on May 24th and 25th. Two animals were seen beginning to lose some hair. One animal was losing the hair from the front quarters and the other from the hind legs.

The normal procedure of shedding seemed to be a loss of pelage from the shoulders first, as shown in Figure 7. Hair on the legs and chest was shed next. Gradually the molt line progressed posteriorly until it reached the rump region which was the last to lose its patch of long hair.

The hair came loose as if it were shorn. Large patches often came loose from the body but remained attached to the unshed portion by a matted condition. Loose patches were often seen flapping in the breeze. Small bits of hair were often picked from shrubs or off the ground along well-used trails. In one case a patch about two feet square was found on the ground at the place where many animals often bedded.

There is evidently a slight irritating sensation during the time of shedding. On many occasions animals were seen rubbing against rocks or brush, or even along the ground. During July those animals which were partially shed often knelt down on snowbanks and rubbed their front quarters quite thoroughly on the hard snow.

The time of shedding and duration of the shedding period seem to vary noticeably with the age and sex of the animals. Lone adults, a billy in the one instance in which sex could be identified, were first to start

shedding and the first to appear with the sleek-looking new coat. This usually took place by about the middle of July. By the first of August most females were either completely shed or had only a few old hairs left on the upper portions of their hind legs. Shedding seemed to progress more rapidly for the barren females than for those with kids. Yearlings appeared to be the last to start and the last to finish shedding. Two yearlings observed in July had very small patches of the old coat shed and others showed no signs of shedding. One yearling observed on August 7th had shed only a narrow strip extending along the top of its back. The first cleanly shed animals of this age were seen on August 27th.

As the new summer coat got older and grew longer it took on stains of various sorts which aided some in winter observation of the animals. These stains appeared as greyish or yellowish casts and were usually persistent until the hair was shed the following spring. The greyness was a result of soiling from the dirt and debris with which the animals came in contact. The theory expounded by oldtimers regarding the yellowish coloration is that it occurs only in the billies and comes from a repeated saturation of the hair with their own urine. The authenticity of this cannot be vouched for by any evidence found in this study.

Another common discoloration has been observed often during the spring. Six goats observed in the Bitterroots during early May showed reddish-hued patches on their throat and neck regions and in some cases it extended down between their front legs. Nickolas Kramis, of the United Public Health Service in Hamilton, Montana, has also observed a number of similar cases in early spring. One such animal collected by that Service was found to be heavily infested with ticks (Dermacentor andersoni). It was Mr. Kramis' opinion that the reddish coloration resulted from the parasites' excrement becoming wet and forming a stain that spread over the hair. Three goats observed near Red Butte during May and early June had this same type of discoloration about the neck. Ticks were known to be quite abundant during the spring in most all areas inhabited by goats.

The underwool of our mountain goat, according to Seton (1929), has been described by wool experts as finer than cashmere, and was used by natives in the north country for weaving the famous Chilkat blankets.

An abundance of coarse guard hairs is also present. They may grow to lengths of seven inches on some portions of the body. It is this mass of guard hairs that gives the characteristic profile to the mountain goat as seen in many pictures of this report. His prominent chin whiskers aid his ambiguous acquisition of the name "goat" from the similarity to whiskers of the domestic goat. In the fall and winter the goat appears to have socks on all four feet. The shaggy coat extends down each leg to within six or eight inches of the hoof and suddenly breaks off leaving only the short hairs for the remaining leg length.

The bulkiness of the entire pelt often leads to an overestimation of the size and weight of the animal. Long yearlings are often difficult to distinguish from adult nannies when both are cloaked in their heavy winter coats. Only in exceptional cases can males and females be distinguished by their apparent size during the winter.

Winter winds and sub-zero temperatures of typical mountain goat habitat do not seem to disturb these animals because of this heavy protective coat. However, the wool of the goat is not fed by oil glands as in the case of sheep. It therefore remains almost crispy dry. It is not repellent to the penetrating rains common in their habitat. Animals are known to seek out shelters from rain and snowstorms. It is believed that if the animal could not get into some kind of shelter its coat could easily become soaked through to the skin. In cool weather this might result in diseases caused by exposure.

Figure 8

Horn Gland of Mountain Goat

Glands

A unique characteristic of mountain goats is the glands occurring just posterior to the base of the horns in both females and males (Figure 8). The glands examined were black and appeared quite prominent. They were somewhat larger in the males than in the females. They were in the form of a crescent 1½ to 2 inches in diameter reaching nearly halfway around the horn. The widest portion was often ½ inch wide. The glands were leather-like but quite pliable, probably kept so by an oily secretion. There was no particular odor to which we were sensitive.

It is generally believed that most excretory glands of wild animals are closely associated with sexual activity and communication. There was no evidence brought out in this study that would suggest what part these glands play in the sexual activity of the goat. There was also no explanation for this type of gland occurring in both sexes. Animals were seen slashing repeatedly at clumps of bushes with their horns. This was believed to be an effort to stimulate the horn glands. Most such activity was observed during

September and October, just preceding the rut. One animal, the sex unknown, was observed on July 17th engaged in this activity for a period of about two minutes. There is a possibility that the function of these glands is to contribute dressing for the horns to keep the sheaths from becoming brittle.

Feces

Mountain goats and mule deer often range in the same locality, and it is often difficult to distinguish between their droppings. The consistency of an animal's droppings is dependent in part on the diet of the animal. At the time animals are feeding on succulent spring growth, there is no marked difference in the pellets of goats and deer. After the feed starts to contain more fiber and less water the pellets assume a more definite characteristic shape. Those of goats may usually be identified (Figure 9) by a longer, more drawn out point on one end than those of deer and by being broad and flat or concave on the other end. The deer pellet is more symetrically oval in outline. In general, goat pellets are not quite as large as those of the adult mule deer.

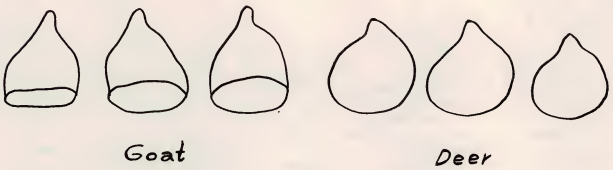


Figure 9

Outline of Typical Feces of Mountain Goat and Deer

Sounds

Adult goats were never heard to utter a sound of any kind. Yearlings seldom emitted sounds. Just once a yearling was heard to bleat quite sharply, much like an older domestic lamb. During the summer kids were observed to get lost from their mothers on several occasions. All the while during the time they were trying to find their mothers they would voice their frustration

by a constant plaintive bleating, quite similar to that of a young domestic lamb when lost. It was not uncommon to hear this bleat a third to a half mile away.

The presence of goats was often made known by the sound of rolling rocks which accompanied most of their movements. That sound occurring long after dark one night prompted observers to investigate. A goat was found moving along a narrow ledge of a nearby cliff. Day or night, there seemed to be little stealth in their movements.

Adult goats made a characteristic gesture which may or may not have been done for the sound effects. When approached within close range, an animal would repeatedly strike the ground with sudden thrusts of a forefoot. There was a definite thud from this striking which could be heard or seemingly felt for quite some distance. The gesture may have been just a nervous reaction or possibly an alerting signal to other animals.

Senses

Any conclusions concerning the ability of an animal to smell, hear or see must be based on circumstantial evidence deduced from the observed reactions of animals under various conditions. During this study observers had many occasions to observe sensorial reactions in goats, but found they were not always consistent in nature, leaving factual conclusions poorly substantiated. The following discussion summarizes such observations as were considered significant.

Smell

The olfactory sense seemed to be relied on by goats under many conditions, but apparently it lacked the sensitivity found in most other big game species. Any odors left in fresh tracks or camp grounds of humans aroused no noticeable reaction in a goat. Setting traps or creating artificial attractions requires little or no precaution in eliminating human odors which might be left. While stalking goats little attention need be given the direction of the wind until the stalker is within close range of the animals. On several occasions an observer remained motionless and goats came to within ten feet of him before showing awareness of his presence. They they would act inquisitive and watch the observer for a while, turn and go about their former activities until they got directly downwind from the observer. Then they became alarmed and left promptly.

Only on a few occasions were goats observed smelling the genitalia, tail regions, urine or feces of other goats. Rutting season activities have not been observed enough to be able to relate whether any increase in such activities occurs at that time or not.

Both nannies and kids apparently identified each other by smell. A lost kid would approach every goat in sight and apparently determine by only a brief smell whether or not the animal was its mother. Also the mother, in looking for her lost offspring, would approach all kids within view to identify them with only a brief smell until she found her own. She would then smell the kid over thoroughly before resuming normal activities.

Hearing

Response to noises was highly variable in goats. Human voices on several occasions were not too alarming to an animal if not accompanied by movement. On hearing sounds they would often stand and look in the direction from which the sound came with an inquisitive attitude in their posture. They would perhaps remain motionless until they detected movement.

Some animals could be dispatched instantly by the sound of rolling rocks or falling snow. Other animals would pay little or no attention to such sounds and might continue to graze without displaying any evidence of having heard the sound.

Gunshots would usually not alarm the goats unless they were at close range or they had been shot at recently.

Sight

Probably the most keenly developed of the mountain goat senses is that of sight, especially for detecting movement. As stated before, an observer remaining absolutely stationary usually was not noticed readily by animals, but when the animals detected the individual, they would study a short time and then resume their original activities without apparent alarm. Movement immediately attracted their attention even at great distances. Several times at distances of a mile or a mile and a half, goats detected our movements, even when we wore inconspicuous clothing and were camouflaged against backgrounds of assorted vegetation or rocks. This detection did not necessarily cause alarm to the animals but there was no doubt in most cases that they were well aware of our presence.

LIFE HISTORY OBSERVATIONS

Mating

Attempts thus far at making observations of goats during their mating period have been impeded by inclement weather. The exact period of mating is not known. Seton (1929) cites the incident of a kid goat born in the Bronx zoo on May 20, 1908, after a gestation period of 178 days. Young are known to be born during May and early June in the Red Butte area. A nanny taken during live trapping operations in the South Fork of the Flathead gave stillbirth to a kid on June 13, 1949. The disturbance to this mother animal most likely caused the death of the young, and may have delayed the birth a few days. If the gestation period of our goats is similar to that of the goat cited by Seton, it would indicate that the rutting period is in November and the early part of December.

Some sexual stimulation no doubt occurs in some animals before this time. In late September and October goats have been observed slashing at bushes with their horns. It was thought that this was an effort to stimulate activity of the horn glands. If so, then it would possibly indicate the beginning of sexual activity.

Birth

The earliest date any kids have been reported was by a Park Ranger in Glacier National Park, when a kid was reported seen in upper Park Creek Valley on February 27, 1935.

A nanny with a very small kid was observed near Red Butte on May 26, 1948, in the same vicinity where a single lone adult had been seen throughout the previous day. It seemed likely that parturition had taken place some time between these two observations. Another nanny with a small kid was seen that same day a short distance from the first, walking on a narrow ledge along the face of the cliffs.

Four of twenty-four animals observed on May 30th were kids and no more than two kids had been observed in the area since observations started on May 26th. On June 6th, seven kids were counted and an additional one was known to have been taken by an eagle on June 2nd. This evidence lead us to believe that these seven kids were born between May 25th and June 6th.

The stillbirth of a kid on June 13th has been cited. This is the only evidence of any births occurring as late as the middle of June.

During the kidding period each herd of animals was usually scattered widely over an area. The animals occurred either as single individuals or in small groups of two to four animals. In most cases nannies with small kids ranged by themselves and it is thought that those nannies were some of the single animals observed earlier. In almost all instances of animals occurring in groups, there were no kids present. This evidence lead us to believe that pregnant females seek isolation before and during parturition and for a few days thereafter. No evidence was noticed to indicate that nannies deposit their young in hiding while they feed, a common custom of deer, elk and antelope. Adults without kids were watched closely to determine if any would occasionally return to hidden young. None were ever seen to do so.

The adaptation period for the young was brief. Apparently the roughest type of terrain was preferred for kidding beds, possibily as protection from predators. But the exceptional ability to navigate the rough terrain while still in the spindly stage of infancy was manifested throughout all spring observations.

Careful observations were made to determine the occurrence of twinning in mountain goats. Of 88 individual kids observed in this entire study, there was evidence for only one probable case of twinning. A lone nanny seen in the Swan range during August was being followed by two kids which acted as if they both belonged to her. These may have been twins.

Juveniles

The age at which mountain goats begin sexual activity is not accurately known. Evidence at hand to date indicates that they may breed at the age of 17 to 19 months and are two years old when they drop their first young. Animals up to two years of age will therefore be treated as juvenile and

those older as adults.

Growth

At birth kids weighed from six to nine pounds. During the first year their weight increased by about seven times to around 45 pounds. In the second year the rate of increase was slower. During that time they increased only by about two or three times their birth weight, to weigh 60 or 65 pounds.

Body length of a kid goat when born was about 21 or 22 inches. Within the first year it increased to approximately 38 inches. During the second year it increased to between 42 and 46 inches.

Height at the shoulders increased from about 14 inches at birth to approximately 24 inches when a yearling, and 28 inches when two years old.

Horn growth was perceptible on close examination at birth. At two or two and a half months the length growth could be seen in the field and increased to three or four inches the first year. It added another two or three inches the second summer season, but little or no growth the second winter. At two years of age the horns were about six inches long.

Nursing and feeding

Some observations of frequency and duration of nursing are presented here from field notes made during the study in the vicinity of Red Butte:

"May 30, 1948. A nanny with a kid not more than a few days old, rose from where they had been bedded close together. The kid began to nurse standing alongside the nanny, wiggling its tail all the while. As it nursed, the mother was seen to lick the posterior region of the kid. After about 70 seconds the nanny lifted her leg over the kid and walked away. The kid attempted to nurse again as the mother walked along, but was knocked over in apparent disregard by the mother. After getting up again the kid stood still for a moment before continuing to follow its mother.

"June 1, 1948. A nanny and kid observed continuously from 12:30 until 4:00 P.M. had the following schedule of activity:

12:30 Nanny and kid were bedded beside each other.
1:00 Both rose from their bed. The mother stood still to allow the kid to nurse for three and a half minutes and then went about feeding as the kid followed by her side.
1:44 Kid nursed again for four and a quarter minutes.
2:20 Kid nursed the third time for a period of one and a quarter minutes.
2:50 Kid lay down for three minutes as the mother continued feeding.
2:53 Kid got up and walked to where nanny was grazing and nursed for 30 seconds. It looked as though the kid took an occasional bite of forage.
3:00 Kid nursed 25 seconds before the nanny walked away.
3:04 Kid bedded down close to the nanny who was still feeding.

3:20 Kid got up and walked up the slope to where the nanny was grazing and bedded down again.
3:28 Last procedure repeated.
3:39 Procedure repeated again.
4:00 Nanny bedded down for the first time in three a a half hours about ten feet below the kid.

"June 1, 1948. Within a fifteen minute period one kid was seen nursing four times for periods of fifteen to thirty seconds duration each. Another nanny rose from her bed and allowed her kid to nurse three and a half minutes before re-bedding in the same place. Two other nannies let their kids nurse for periods of two and four and a quarter minutes respectively."

By the time kids were about six days old they were taking some forage. The one animal mentioned above was apparently taking forage when not more than a day or two old, although the animal was some distance from the observer and the kid could have been just nosing the ground.

Kids still continued nursing for some time after starting to take forage, but the duration of nursing periods became conspicuously shorter.

On June 22nd, a kid was observed to nurse for one minute. On the same day three other nannies walked away from their kids as they attempted to nurse. On July 12th, three kids were observed to nurse once each, but for less than a minute in each case. That same day another kid was attempting to nurse as its mother grazed but on each attempt the female walked away from the kid.

After the first of July, many kids were observed to go for several hours without attempting to nurse. Usually any attempts were either checked at the start or after brief periods of only a few seconds in an apparent attempt of the mother to wean the young. At this time kids were often seen spending as much time grazing as the adults, and on July 12th two of seven kids in a herd of 34 animals were seen ruminating.

Occasionally nursing was observed in August, but only for brief periods, and not more than two or three times a day. At this age, the young were getting so large that it was necessary for them to kneel while nursing.

A nanny collected with her kid in the Bitterroots in September, 1944, was still lactating. It is not known how late in the fall nursing continues.

Adults

Growth

Some changes in body sizes and weights usually occur even after goats become adult. These changes consist of both increases and decreases in size and weight. Increases result from continued maturing growth. There is little evidence presently available to indicate the age at which growth ceases. If the aging of three and four-year old animals has been correct and the animals represent normal growth for those age groups, then full growth of an animal

is probably reached at about four years of age. It is believed that decreases in weight occur for most animals during the rigorous winters when feed becomes scarce, and that this weight loss is normally recouped during the summer. There is no data available which indicates how much this seasonal fluctuation amounts to.

Sexual differentiation in body sizes occurs as animals approach maturity. From information presented previously, it is apparent that females may increase in weight from about 60 or 65 pounds at two years of age to an average of 126 pounds when full grown. The greatest weight of an adult female in our records is 158 pounds. Body length during adult growth increases from about 44 inches to an average of 55 inches. Their height at the shoulders increases from 28 to an average of 34 inches. Horn length increases from about 6 inches to 8½ or 9 inches. According to our records, males increase in weight from 60 or 65 pounds to an average of 135 pounds, and a maximum of about 194 pounds. Body length increases from 44 inches to an average of 58 inches. Height at the shoulders increases from 28 inches to about 38 inches. Horn length increases about the same or occasionally more for males than for females--from 6 to 9 inches, with 10-inch lengths occurring occasionally for males.

Sexual activity

The fact that nannies were frequently followed by both kids and yearlings may indicate that females give birth to young each year. On October 15, 1947, a female and a yearling following it were both killed on Crimson Peak in the South Fork of Flathead River. There was no kid around and the nanny was not lactating. She may have lost the kid from an accident or from predator activity which was quite evident in that area.

Maximum breeding age is not indicated in any information available. Whether or not goats continue breeding until they die, even of old age, is not certain. The age to which these animals live may only be a guess at this time. Nanny numbered "14", which was found dead of malnutrition, had all her teeth, but they were worn quite smooth. Men familiar with the wear which occurs on the teeth of domestic animals estimated that those of the nanny indicated she was between 10 and 15 years old. She was found on January 15th, yet had no embryo present. Whether this was due to senility or to bad health was not determined.

BEHAVIOR AND CHARACTERISTIC ACTIVITIES

Gregariousness and Group Sizes

On many occasions mountain goats have shown a preference for the company of other goats. However, Table 11 indicates that many single animals were seen through the spring and summer seasons. This table shows the grouping of those animals observed during the 1946 census of the Continental Divide Unit and those seen during the aerial survey of the Bitterroots made in May, 1947.

TABLE 11

GROUP SIZES OF MOUNTAIN GOATS OBSERVED

	Continental Unit		Bitterroot	
Group Size	No. of Observations	Number of Goats	No. of Observations	Number of Goats
1	50	50	44	44
2	39	78	10	20
3	13	39	5	15
4	11	44	2	8
5	4	20		
6	1	6	1	6
7	1	7		
8			1	8
12	2	24		
14	1	14		
15	1	15		
40	1	40		
Total	124	337	63	101

In most cases when lone goats were seen they were believed to be billies. Each time the sex could be identified this was found to be true. Often two or three billies fed in the same general area, although they were out of each other's sight. They were evidently aware of each other's presence for they would eventually drift together with all indications of expectancy. On some occasions a lone billy that was disturbed by the observer would run near another billy not noticed by the observer and both animals would move off together. This does not indicate necessarily that billies always seek seclusion from the herd. Males have been definitely identified in some of the larger groups. Also, without actually knowing the sex of many goats seen alone, it cannot be said that they were all billies.

The grouping of nannies, kids and yearlings was quite noticeable during the summer. They would intermingle quite freely in larger numbers or separate into their own little family groups. Often daily get-togethers took place as the animals spent the last two or three hours each evening feeding. They seemed to have some prearranged meeting ground and gradually drifted together into the night's bed ground. It is believed that an incentive for the grouping of nannies, kids and yearlings was a pooling of their protective

efforts against predators.

At the actual time of kidding there was the least grouping of any time during the year. Pregnant females were usually by themselves. Yearlings had been abandoned by their mothers and were left to get together in small groups of two or three or take up with other adults. As the summer progressed, the smaller groups would get together oftener and by fall the tendency was to stay in larger groups most of the day. In winter the animals usually ranged together. This was to their advantage in the deep snows. Trails in the snow were started early in the winter and became well-used and easily navigable as the animals passed back and forth, single file, among the scattered open spots of available feed.

Figure 10

A Group of Nannies and Kids in Early August

Kid-Adult Relationships

For the first week or ten days of their lives, the young animals stayed close to their mothers, never venturing more than just a few feet away. While the nanny moved about feeding, her kid frequently roused from its rest to move closer to her. Occasionally the kid would go to sleep and fail to follow its mother. She would disappear from view before realizing the kid was not along. Upon realizing the absence of her kid, the mother would suddenly retrace her steps to locate the kid. She would then smell it over thoroughly as though to assure herself of its safety before trailing it away again.

Nannies were not tolerant of other animals near them, even other kids than their own. A nanny would usually rush at another animal with a few fast steps to frighten it away. Usually, if one of two young animals playing together approached too closely to the other's parent, it would be driven away.

Unless frightened and running, a mother goat would seldom permit other than her own kid to follow her, at least at close range. Often in May and June a yearling would be following a nanny and kid. Apparently the nanny was the mother of the yearling, yet she would never let it approach her or her kid too closely.

When watching a herd of animals bedded down, it was often difficult to determine the number of kids present. They would usually bed down on the uphill side against their mother. Unless the observer was looking down from the top, the pair appeared as a single goat.

The physical limitations of the young animals did not always seem to be recognized by their parents. Adults would go on normally about their activities on ledges or cliffs, evidently expecting the young to follow. On one occasion during the third week in June, one mother goat started up a steep set of broken ledges. Her young followed marvelously well until it reached a ledge too high to jump up on. The nanny stopped and watched her young make several unsuccessful attempts to follow her. The nanny waited without backtracking a step to help or relieve the situation. The kid finally went around another route to reach her.

Kids were known to continue following their mothers through midwinter and at least until in March. Just how and when nannies abandon their young, previous to bearing their next young, was not observed during these studies. All evidence indicated that a nanny was alone just preceding, during and for a short time following parturition. But they sometimes allowed a yearling, apparently their own, to follow them and their kids for a period in the spring.

By the middle of July the yearlings often appeared to be finally abandoned by the parents, either having been so from the time of birth of the new young or else abandoned a second time after having followed their own parents for a brief period.

After the first of July, two different yearlings in the Red Butte vicinity could easily be identified for some time by the condition of their shedding. Both yearlings were thought to be abandoned by their mothers who probably were caring for more recent young. One of these yearlings had a shaggy, partially-shed coat for about two months which, together with its posture and activity, gave it the appearance of being in poor health. This yearling was observed to follow a large billy almost everywhere, much as a young kid would follow its mother. The billy never seemed to mind or pay any attention to the yearling as he continued his normal activities. The billy was never seen to defend the yearling in any way, and there was no apparent adoptive measure on his part except his tolerance. The other yearling followed an adult at times, but not so doggedly. We could not be sure whether it was the same adult all the time nor what its sex was. These observations indicated a tendency for yearlings, abandoned by their mothers when they bore new young, to seek a foster parent, regardless of sex involved. And it may have been that billies were the only ones tolerant of this foster role.

Playfulness

Kids spent much of their time in play, either alone or with another kid. On May 26th, the earliest date kids were seen in the Red Butte area, a kid was friskily running and jumping as it crossed a snowbank with its mother. Similar performances were seen often when kids got onto snowbanks.

A great pastime of young goats was to climb around and over their mothers as the latter were bedded down. The nannies never seemed to encourage this activity, but were always tolerant and never moved to avoid the annoyance. During these playful gestures a kid would sometimes stop and smell and possibly lick the nose of its bedded mother. There was no apparent playfulness in any adults toward kids, nor toward other adults.

Two or three kids were frequently observed playing together. Their play often consisted of mock battles in which they would strike at each other with their heads while jumping from side to side. Or they would chase around, jumping back and forth from ledges or high points in a frolicking manner similar to the young of domestic sheep or goats. This type of play in the most rugged terrain certainly demonstrates agility from the early stages of the goats' life.

Bedding

A large portion of a mountain goat's life seems to be spent bedded down. Many of their activities were centered around their bedding sites. They would bed down several times during the day alternating their rest periods with periods of grazing. In summer these daytime bed grounds were often picked with some evidence of conscious selection. On hot afternoons they were usually found on some cool site such as the top of a snowbank, in the shade of a ledge or on a rocky point in the wind. This was especially true if the animals still retained part of their previous winter's heavy coat. It is believed that they seek out localities in the wind to keep cool and as protection from flying insect pests. Adult goats seldom went to sleep while bedded during the day. They were usually ruminating and looking over the country, over which they had a wide view.

At night there seemed to be no particular selection of bedding sites based on physical qualifications. A large group of animals has been seen to move to the crest of a ridge and bed down for a night. On other occasions the same group has been seen bedding down on wide grassy terraces amongst the cliffs. Smaller groups are known to bed down along the crest of rocky ridges, along the narrow ledges of cliffs or occasionally near the base of trees.

Some bed grounds showed evidence of repeated use although there was no evidence that any single animal or group of animals had a preference to return repeatedly to the same bed site.

Some bed sites used quite commonly in the summer were dusting beds. An animal would spend an hour or two just lying in a dusting bed, occasionally pawing up a big cloud of dust with a front foot, sending it back over his body. Occasionally he would rise, shake himself, and lie down again to repeat

Figure 11

Mountain Goat Bedded Down

Figure 12

Mountain goats spend much of their time on remains of snowbanks.

Figure 13

Dusting Bed Used Frequently By Mountain Goats

the procedure. Some dusting beds, such as that pictured in Figure 13, had been dug quite deep as a result of continual use. It is believed that this dusting serves partially to ward off insects and to drive insects from the animal's pelage.

During periods of inclement weather, goats have been known to seek shelters against the driving rains and snows. Overhanging ledges were the most common shelters. Caves, similar to the one shown in Figure 14, were often used when available. Indications were that they may stay in shelters for days awaiting the end of a stormy period.

Sanitation

An indiscriminate accumulation of goat feces was usually associated with the most commonly used bed grounds. There seemed to be no hesitation on the part of goats to defecate or urinate within the bed site right after rising from it. Apparently there was also no hesitation on their part to bed down in a site almost completely covered by droppings. These sites were usually in well-drained areas and the droppings were in a dry, pellet state within a short time after their deposit.

Details are presented later regarding the sanitation in connection with salt licks and wallows. It is doubtful that the excreta inhibits the desirability of these licks. In fact, it is possible that the mineral content of the excreta enhances the attraction.

Figure 14

Small cave known to be used in winter by mountain goats.
Flatiron Mountain - South Fork of Flathead

Figure 15
Fecal deposits in a commonly used bedding site.

Movements

The attitude and posture of a walking adult goat is not the delicate supple gait commonly thought of in mountain sheep. Instead, it has a more muscle-bound or stiff-legged plodding appearance. Their legs are short, stocky and powerful, apparently well adapted for mobility in the type of terrain in which they are commonly found.

Most steps that a goat takes seem deliberate and well placed, especially in close quarters where balance and sure-footedness are the premium on life. When rushed or frightened, they exhibited a great amount of natural agility. The goat would meander about on some very narrow ledges or climb up and down precipitous walls with ease. Sometimes they retraced their steps and took another route to avoid the extremes of terrain, but this was seldom. When under pressure they would occasionally jump a crevice or from one ledge to another, but often during their normal travel they would try another route which allowed them to walk instead of jump.

Many times when goats were encountered at close range they would amble off at an unhurried pace until out of sight of the observer. As soon as they were out of sight, they would speed up their gait to a trot or a run and rapidly widen the distance between them and the observer. This was noticed several times when it was possible to make second observations of the animals.

Migrations

Daily

Goats came from the bed ground in the morning just at sunrise to feed for two or three hours. For a period after that until mid-afternoon they alternately bedded down and fed. In the evening they would feed for a period of two to three hours, or just move around over cliffs before bedding down before dark.

This schedule was not a rigid one. Factors such as weather, time of year and feed conditions influenced it. During stormy periods there was little or no activity on their part. Just following a storm they usually spent all the daylight hours feeding.

In the spring there was a daily movement between salt grounds and feed grounds. Some of this movement took place at night, but little is known of the extent or frequency of such movements.

The shortage of feed in winter and the short days may account for goats often spending all of the daylight hours feeding or apparently seeking feed.

Seasonal

A need for a migration to other areas for wintering occurred for many goat herds. Food was not available in winter on some ranges used during the summer. In such cases the animals usually migrated to lower altitudes or to other high ranges where wind action made forage available.

Goats wintering in the Rattlesnake drainage north of Missoula would come down from the Mosquito Peak and Stuart Peak summer range. It was believed that the goats wintering on Flatiron Mountain in the South Fork of Flathead River came down from the Flathead Alps where they summered. Those goats summering around Junctior Mountain and the Pearl Basin country of Sun River were believed to go down into the lower country of Ahorn Creek. In contrast, it is known that more than 20 goats spent most of the winter of 1947-48 on or near Red Butte, the same range used during the previous summer.

An early spring migration back to the summer ranges usually occurred as soon as the snow left. Following that there was often a migration to salt licks. Many artificial salt licks have been established lately within goat habitats, thus eliminating the necessity for long migrations to natural licks. Some regular spring use of the larger natural licks still occurs. It is not known how far the animals move to get to such licks. In a few cases it was at least three to five miles from the main summer goat range to the lick.

Most salt use was over by the first of August. From then on goats were usually on their summer ranges until the beginning of any fall migration. Any summer movement from one general area to another seemed to be erratic and not the usual case.

Two instances of mass summer movement were noticed, for which we could give no logical reason. On Spotted Bear Mountain and near Crevice Lake, both in the South Fork of Flathead, there were herds of goats seen almost daily through the first part of the summer. Some time in early August these herds moved out of their respective territories and were not seen any more that fall. Where these goats went and the reasons for their sudden departure were not known.

Reactions to People

Mountain goats have inquisitive natures in their undisturbed primitive state, but in areas where they have been shot at a few times they were alert and evasive. One herd near Molly Creek Pass between the South Fork of Flathead and Sun River was known to be an inquisitive group and would watch people below without much alarm. Just at the close of one hunting season goats were seen feeding in that area, headed down hill towards the observers. Normally they would have continued feeding along the slope or would have stood and watched people crossing below them. This time the goats saw the observers three-quarters of a mile away and immediately turned and ran over the top of the mountain. This change of character was thought to have resulted from recent visits by hunters. It was later reported that hunters had taken a goat from that group two days previous to this observation.

Some of the indifferent or inquisitive reactions of goats to people have been described under "Senses" and some will be given in "Live Trapping and Transplanting".

The curiosity of these animals when at close range could often be encouraged if the observer made a slight noise without any movement. If the observer smacked his lips it would sometimes cause goats to approach much nearer.

The peculiar gesture of stamping the ground repeatedly with a front foot when standing at close range was mentioned under "Sounds". This gesture may or may not have been peculiar only with their encounter with humans.

FOOD HABITS

In studying food habits of goats there are definite limitations to the use of techniques which have been successfully applied to domestic livestock. Close-range observation of individual animals feeding was extremely difficult and usually impossible. Stomachs were sometimes taken for analyses but so far it has been impractical to collect them from normally feeding goats. The one method found most feasible for evaluating food habits was to measure the amount of utilization of the various forage species occurring on the range. It could logically be assumed that results of this measure were indicative of the food habits of the animals using that range. This method also gave results on a herd basis rather than on an individual animal basis. This type of an analysis was chosen for use in this study and techniques were developed for determining the food habits of mountain goats on two representative ranges in western Montana.

The first was range in the Red Butte area at the headwaters of Sun River, west of Augusta. This is a historical yearlong goat range about two square miles in extent. It is closely associated with more extensive range along the Continental Divide. From 20 to 40 goats frequented this area, but may have moved back and forth to the Divide area. At one time timber was the predominant vegetative cover. This was destroyed by a 1916 fire and at the present time there are various associations of shrubs, grasses, and forbs with only a scattering of dwarfed alpine trees. The west side of the Red Butte area is composed of steep slopes. The east side is a broken and precipitous exposure of cliffs and ledges. Four prominent cirques on the east side give rise to the drainage system which extends down into the West Fork of Sun River. Much of the summer feeding occurred within these cirques. Most of the winter range is on the west and south ridges which are blown bare of snow by the constant westerly winds. Both summer and winter studies were conducted on this range.

The second study area had winter use only, and is located in the Rattlesnake drainage about 15 miles north and east of Missoula. The elevation is 4,000 to 5,000 feet above sea level. The area consists of a narrow belt of south-facing cliffs with the accompanying talus and border timbered areas. It makes up about 500 acres of the north and east wall of Rattlesnake canyon. The cover type is predominantly mature douglas fir (Pseudotsuga taxifolia) and yellow pine (Pinus ponderosa) timber, except on the open cliffs. These open cliffs are spotted with patches of browse, herbs and perennial grasses.

Terrain and utilization features of each of these ranges did not lend themselves to a random sampling procedure for analysis.

All measurements of vegetation for these studies were made by the weight estimate method described by Pechanec and Pickford (1937). The unit of measure was tenths of ounces. As suggested by the same authors, the estimator's conception of units of weight for each species was continually checked in the field by clipping and weighing.

The vegetative cover on both goat ranges was mapped by types which were based on composition. Vegetative type boundaries on each range were identified from aerial photographs by the lines separating distinct differences in vegetative composition.

Within each vegetative type the following evaluations were made:

1. Relative availability: The available volume of each species in sample plots was tabulated and converted to percentage. The arbitrary standard set for "available forage" was: All the accessible branches of browse one quarter inch in diameter or less and all exposed parts of grasses and forbs above ground level.

Petrides (1941) in New York, Hill (1946) in South Dakota and Aldous and Krefting (1946) working with moose on Isle Royale have all pointed out the importance of range composition to the ultimate food habits of an animal.

2. Indicated use preference: This was the relative amount of use made of each species. The amount was computed from the per cent of plants showing utilization multiplied by the average degree of utilization of the plants used. It was expressed as the per cent utilization of the total amount available. For example, if 50 per cent of the available plants of a single species showed utilization and the average use made of them was 50 per cent of their weight, then 25 per cent of all the available weight of this species was utilized. This figure could thence be compared with that for other species to indicate comparative degrees of use, and may be considered an indicator of use preference.

3. Diet: The rating given each species was the per cent of each species in the food taken from that range. It was an expression of the degree of use made of each species as modified by the abundance of that species.

These three evaluations were then weighted by the area and production of the respective type to determine the relative value of each species for an entire range. In addition a fourth value was given to each species for each entire range unit. This was:

4. Importance as food: This was a descriptive expression of how prominent each vegetative species was in the diet of the animals feeding on that range. This prominence was subject to some direct influences: namely, the specific area, the season of year, the vegetative composition and the preference for the various species. The results presented in this study indicate the prominence of the various species for each specific range, season and composition indicated. They do not necessarily represent the conditions which might be found on other goat ranges of Montana. Further studies will be needed to provide more generalized food preference tables for mountain goats.

Summer Food Habits

Only the Red Butte range was analyzed for summer food habits. Analysis of the vegetation and utilization was made at the time utilization was considered to be near optimum. That is, normal feeding had been taking place long enough to give a measurable feeding pattern for the season, but had not advanced to a stage of forced feeding. At that time there should have been no abnormal use of less palatable species as a result of the more desirable species disappearing. Therefore, results shown in the summary of summer food habits, Table 12, indicate the normal relative preference of the goats for the different species of forage on the area studied.

TABLE 12

SUMMARY OF FOOD HABITS OF MOUNTAIN GOATS ON SUMMER RANGE
(Red Butte, 1947)

Scientific Name	Common Name	Relative Availability		Indicated Use Preference		Per Cent of Diet	Importance as Food
		%	Degree	%	Degree		Degree
Vaccinium scoparium	Dwarf huckleberry	49	High	12	Mod.	96	Very high
Pentstemon ellipticus		1	Very low	12	Mod.	1-	Very low
Heuchra glabella	Alum root	1-	Very low	11	Mod.	1-	Very low
Astragalus sp.		1-	Very low	9	Mod.	1-	Very low
Aster sp.	Aster	1-	Very low	8	Mod.	1-	Very low
Pedicularis groenlandica	Elephanthead	1-	Very low	7	Mod.	1-	Very low
Poa alpina	Alpine bluegrass	1	Very low	5	Low	1-	Very low
Hieracium scouleri	Hawkweed	1-	Very low	5	Low	1-	Very low
Carex geyeri	Elk sedge	4	Low	4	Low	3	Mod.
Silene multicaulis	White catchfly	1-	Very low	3	Low	1-	Very low
Vaccinium membranaceum	Huckleberry	1-	Very low	3	Low	1-	Very low
Hypericum scouleri	Scouler's St. Johnswort	1-	Very low	3	Low	1-	Very low
Antennaria rosea	Pussy toes	1-	Very low	2	Low	1-	Very low
Sedum stenopetalum	Yellow stonecrop	1-	Very low	2	Low	1-	Very low
Arnica latifolia	Broadleaf arnica	1-	Very low	1	Very low	1-	Very low
Festuca idahoensis	Idaho fescue	1-	Very low	1	Very low	1-	Very low
Arenaria formosa	Grass sandwort	1-	Very low	1	Very low	1-	Very low
Veronica wormskjoldii	Alpine speedwell	1-	Very low	1	Very low	1-	Very low
Achillea lanulosa	Yarrow	1-	Very low	1	Very low	1-	Very low
Senecio triangularis	Arrowhead ragwort	1	Very low	1	Very low	1-	Very low
Juncoides sp.		1-	Very low	1	Very low	1-	Very low
Eriogonum umbellatum	Sulphur plant	1	Very low	1	Very low	1-	Very low
Juncus parryi		1	Very low	1-	Very low	1-	Very low
Xerophyllum tenax	Beargrass	29	High	1-	Very low	1-	Very low
Drymocallis pseudorupestris		1-	Very low	0	None	0	None
Chamaenerion angustifolium	Fireweed	1-	Very low	0	None	0	None
Oryzopsis exigua	Little ricegrass	1-	Very low	0	None	0	None
Koeleria cristata	Junegrass	1-	Very low	0	None	0	None
Agrostis hiemalis	Ticklegrass	1-	Very low	0	None	0	None
Festuca ovina	Sheep fescue	1-	Very low	0	None	0	None
Phyllodoce empetriformis	Mountain heath	7	Mod.	0	None	0	None
Salix sp.	Willow	1	Very low	0	None	0	None
Ribes sp.	Currant	1	Very low	0	None	0	None
Dasiophora fruticosa	Shrubby cinquefoil	1	Very low	0	None	0	None
Total		100				100	
	By Vegetative Classes						
	Forbs	34				1	Very low
	Grasses	7				3	Very low
	Shrubs	59				96	Very high
	Total	100				100	

Temporary sample plots were selected in each vegetative type to represent as nearly as possible the vegetative composition and the normal use made of the type. These were 100-square foot circular plots. Each one was chosen to represent approximately 10 to 15 acres, making the number of plots per vegetative type variable, depending on the size of the type. The results from all sample plots in each type were analyzed collectively. Analysis of each type was then weighted by the size and production of the type to give the resulting evaluations summarized in Table 12.

Of 34 species measured on the summer range, 24 showed utilization, yet dwarf huckleberry (Vaccinium scoparium) made up 96 per cent of the diet in spite of only 49 per cent of the forage available for use. Other species rated nearly as high for indicated use preference, but did not make up a sufficient portion of the available composition to allow for greater use in the animals' diet.

Seventeen of the 24 species utilized were forbs, yet they made up only one per cent of the diet. Most of the use made of forbs was of the flower portions only. In one instance a nanny and kid were observed to literally mow only the large conspicuous blossoms from seven clumps of Pentstemon ellipticus within a period of fifteen minutes. Each clump was about two feet in diameter and loaded with blossoms about two inches tall. This utilization of the flowering portions also occurred on many of the other less conspicuous species. Such species may be termed "ice cream" species in a goat's normal diet.

Winter Food Habits

Both the Red Butte and Rattlesnake ranges were analyzed for winter food habits.

Analysis of winter feeding had to be conducted in early spring, just after the snow had gone but before spring growth had started. Results of these analyses are indicative of the accumulated utilization for the entire winter. The measure of availability considers all the vegetation available in the absence of snow and does not indicate what the actual availability was at the time of use.

There was an attempt to evaluate progressive winter feeding from month to month by the use of permanent plots. The results were not sound due to fluctuationg snow conditions. Band trailing to accomplish this same purpose in detail was much too hazardous to undertake in this precipitous terrain.

The terrain and weather had delimited the use of winter ranges to such spotty occurrence that no latitude in selection of the location of plots was possible. Ledges and open areas where goats were known to feed most were chosen as plots. There was no regularity as to size nor occurrence of plots. An area which had been used intensively by goats through the winter was analyzed as thoroughly as possible, whether it was 100 square feet or a quarter of an acre in size.

All sample plots within each type were analyzed together. Results of each type were then weighted by the size and production of that type to give the final evaluations for each range. These are summarized in Tables 13 and 14.

Figure 16

Some winter mountain goat habitat in the Rattlesnake Drainage.

TABLE 13

SUMMARY OF FOOD HABITS OF MOUNTAIN GOATS ON WINTER RANGE
(Red Butte, 1947-48)

Scientific Name	Common Name	Relative Availability		Indicated Use Preference		Per Cent Importance of Diet as Food	
		%	Degree	%	Degree		Degree
Xerophyllum tenax	Beargrass	1	Very low	85	Very high	2	Low
Koeleria cristata	Junegrass	11	Mod.	71	Very high	30	High
Juncus parryi		1-	Very low	60	Very high	1	Very low
Carex geyeri	Elk sedge	1-	Very low	60	Very high	1-	Very low
Agropyron spicatum	Bluebunch wheat-grass	14	Mod.	52	High	27	High
Poa sp.	Bluegrass	5	Low	26	Mod.	4	Low
Festuca idahoensis	Idaho fescue	1-	Very low	19	Mod.	1	Very low
Salix sp.	Willow	52	High	18	Mod.	35	High
Antennaria rosea	Pussy toes	1-	Very low	0	None	0	None
Achillea lanulosa	Yarrow	1-	Very low	0	None	0	None
Eriogonum sp.		1-	Very low	0	None	0	None
Potentilla sp.	Cinquefoil	1	Very low	0	None	0	None
Vaccinium scoparium	Dwarf Huckleberry	3	Low	0	None	0	None
Ribes sp.	Currant	1-	Very low	0	None	0	None
Dasiphora fruticosa	Shrubby cinque-foil	6	Low	0	None	0	None
Amelanchier alnifolia	Serviceberry	2	Low	0	None	0	None
Spiraea sp.	Meadowsweet	5	Low	0	None	0	None
Total		100				100	

By Vegetative Classes

Forbs		2				2	Very low
Grasses		30				63	High
Shrubs		68				35	Moderate
Total		100				100	

TABLE 14

SUMMARY OF FOOD HABITS OF MOUNTAIN GOATS ON WINTER RANGE
(Rattlesnake Drainage, 1947-48)

Scientific Name	Common Name	Relative Availability		Indicated Use Preference		Per Cent of Diet	Importance as Food
		%	Degree	%	Degree		Degree
Koeleria cristata	Junegrass	1	Very low	63	Very high	19	Mod.
Poa sp.	Bluegrass	1-	Very low	51	High	1	Very low
Agropyron spicatum	Bluebunch wheatgrass	4	Low	37	High	48	High
Artemisia discolor	Sage	1-	Very low	34	High	3	Low
Achillea lanulosa	Yarrow	1-	Very low	6	Low	1-	Very low
Amelanchier alnifolia	Serviceberry	18	Mod.	4	Low	22	Mod.
Acer glabrum	Mountain maple	4	Low	4	Low	4	Low
Rosa sp.	Rose	1-	Very low	3	Low	1-	Very low
Ribes sp.	Currant	9	Mod.	1-	Very low	1	Very low
Philadelphus lewisii	Mockorange	23	High	1-	Very low	1	Very low
Pentstemon sp.		1-	Very low	0	None	0	None
Potentilla sp.	Cinquefoil	1-	Very low	0	None	0	None
Woodsia sp.	Rock fern	1-	Very low	0	None	0	None
Symphoricarpos albus	Snowberry	1	Very low	0	None	0	None
Juniperus scopulorum	Rocky Mountain juniper	12	Mod.	0	None	0	None
Total		100				100	
	By Vegetative Classes						
	Forbs	1-				3	Very low
	Grasses	5				68	High
	Shrubs	95				29	Moderate
	Total	100				100	

Figure 17

Use of Foliage From a Fallen Douglas Fir Tree

On both winter ranges, grass species rated high in the diet--63 per cent on Red Butte and 68 per cent on the Rattlesnake range. Junegrass (Koeleria cristata) and bluebunch wheatgrass (Agropyron spicatum) were the two principal species in spite of their relatively low availability in both areas. Shrub species, mostly willow (Salix sp.) and serviceberry (Amelanchier alnifolia), were of secondary importance on both ranges. They contributed 35 per cent of the diet on the Red Butte range and 29 per cent on the Rattlesnake range.

At no time did forbs form an important portion of the diet. According to Stoddart and Smith (1943) most forb species do not cure well and in the non-growing season are inferior as forage to both grass and browse. The one exception found to this was beargrass (Xerophyllum tenax) which remains green yearlong. In summer less than one per cent of the amount available was utilized, but in winter goats pawed for this species and consumed 85 per cent of the amount made available.

The use of foliage and tips of branches of fallen evergreen trees was noticed in some winter areas. This use of fallen trees may take place even when there is an abundance of the same type of foliage available on trees still standing. The reason for this kind of feeding may be due to an unknown change in the nutritional qualities of evergreen foliage when severed from its food supply. The same type of use is also known to occur by elk on winter ranges.

There has been no way to incorporate the use of mosses and lichens into consideration for this study. Neither the actual occurrence of utilization

nor the amount of utilization can be recognized. This applies to both the club mosses so abundant in alpine areas and the foliacious lichens found within easy reach of goats on most trees and rocks. There is little doubt that this class of vegetation may be important in the goats' diet, but any statement as to the degree of importance would be only a matter of conjecture.

Stomach Analyses

Samples from seven goat stomachs have been collected and analyzed as shown below. Only the first sample listed was taken from a freshly killed animal in good health. The others were from animals whose death during the winter had resulted from either predators, snowslides or malnutrition.

Stomach No. 1:

An adult male killed by hunter on October 17, 1934, in Sweeney Creek of the Bitterroot Range. (Taken from United States Forest Service records.)

	Per Cent
Ceanothus (mountain laurel)	6.0
Berberis repens (creeping hollygrape)	2.3
Pinus contorta (lodgepole pine)	0.6
Rosa (rose)	2.8
Cercocarpus ledifolius (mountain mahogany)	1.2
Pachistima schoeffei (mountain lover)	1.7
Carex (sedge)	63.0
Agropyron sp. (wheatgrass)	13.7
Calamagrostis suksdorfii (pinegrass)	1.2
Festuca idahoensis (Idaho fescue)	4.9
Unidentified	2.0
	100.00

Stomach No. 2:

An adult, sex unidentified, winterkilled about April, 1948, in Chaffin Creek of the Bitterroot Range.

Gramineae (grasses)	50.0
Cercocarpus ledifolius (mountain mahogany)	50.0
Berberis repens (creeping hollygrape)	tr.
Unidentified forbs	tr.
	100.0

Stomach No. 3:

An adult, sex unidentified, winterkilled about April, 1948, in Chaffin Creek of the Bitterroot Range.

Cercocarpus ledifolius (mountain mahogany)	80.0
Berberis repens (creeping hollygrape)	10.0
Gramineae (grasses)	10.0
	100.0

Stomach No. 4:

A yearling, sex unidentified, winterkilled about April, 1948, at Hermit Lake near the West Fork of Sun River.

	Per Cent
Gramineae (grasses)	40.0
Abies sp. (fir)	20.0
Pinus sp. (probably albicaulis - whitebark pine)	10.0
Eriogonum sp. (eriogonums)	tr.
Arenaria sp. (sandwort)	30.0
Unidentified forbs	tr.
	100.0

Stomach No. 5:

An adult, sex unidentified, winterkilled about April, 1948, in the Red Butte area near the West Fork of Sun River.

Pinus sp. (probably albicaulis - whitebark pine)	50.0
Abies sp. (fir)	10.0
Juniperus communis (common juniper)	10.0
Gramineae (grasses)	20.0
Unidentified forbs	10.0
Lycopodiaceae (club moss)	tr.
	100.0

Stomach No. 6:

A short yearling, sex unidentified, winterkilled about April, 1948, in the Red Butte area near the West Fork of the Sun River.

Abies sp. (fir)	70.0
Pinus sp. (pine)	15.0
Picea sp. (spruce)	15.0
Unidentified forbs	tr.
	100.0

Stomach No. 7:

An adult female which died of malnutrition about the first of January and was found on January 15, 1948, in the Rattlesnake drainage north of Missoula.

Pinus ponderosa (needles, yellow pine)	60.0
Pseudotsuga taxifolia (needles, Douglas fir)	38.0
Juniperus scopulorum (juniper)	tr.
Berberis repens (creeping hollygrape)	tr.
Ledum glandulosum (smooth labrador-tea)	tr.
Populus sp. (cottonwood)	tr.
Dry grass	1.0
Impaction mixture of above items plus root fragments, bark and twigs)	1.0
	100.0

These results indicate that, when available, mountain mahogany (Cercocarpus ledifolius) and creeping hollygrape (Berberis repens) might play an important part in the winter diet of goats.

Since some of these animals had died of malnutrition, the remains in their stomachs did not represent normal feeding. However, an interesting fact was noted in this regard. Those animals that died of malnutrition usually had a large amount of conifer needles left in their stomachs. Stomach No. 7 was taken from the carcass of an aged nanny found in the middle of winter in an area where grass and browse was plentiful. This carcass weighed only 67 pounds. A stomach impaction was found and there had been no food or fecal matter in the intestines for some time, yet there were 13 pounds of material in the stomach. This material was made up of 60 per cent yellow pine needles, 38 per cent Douglas fir needles, 1 per cent dry grass and 1 per cent impaction material. This gorging on conifer needles by starving animals has also been found occasionally in elk.

Vegetative Parts Consumed

Studies of domestic livestock have indicated that foraging animals, during normal feeding, are selective as to the vegetative parts of the various species which they take for feed. In some instances this has been shown to be in partial response to the nutritional requirements of the animals. Information gathered during this study of mountain goats indicates some definite selectivity for various vegetative parts of plants during feeding. The selectivity commonly observed is shown in Table 15.

TABLE 15

VEGETATIVE PARTS OF FORAGE SPECIES USUALLY SELECTED BY MOUNTAIN GOATS

Scientific Name	Common Name	Parts Taken
Forbs		
Achillea lanulosa	Yarrow	Flower heads, some green foliage and dead flower stalks in winter
Antennaria rosea	Pussy toes	Flower heads, little foliage
Arenaria formosa	Grass sandwort	Flower heads, little foliage
Arnica latifolia	Broadleaf arnica	Flower heads, little foliage
Artemisia discolor	Sage	Dried stalks and foliage in winter
Aster sp.	Aster	Flower heads
Astragalus sp.		Flowers and green foliage
Eriogonum umbellatum	Sulphur plant	Flower heads
Heuchra glabella	Alumroot	Flower heads
Hieracium scouleri	Hawkweed	Flower heads, little foliage
Hypericum scouleri	Scouler's St. Johns-wort	Flower heads, little foliage
Pedicularis groenlandica	Elephanthead	Flower heads, little foliage
Pentstemon ellipticus		Flower heads
Pentstemon sp.		Dried stalks in winter
Sedum stenopetalum	Yellow stonecrop	Fleshy foliage
Senecio triangularis	Arrowhead ragwort	Flower heads

TABLE 15 (Continued)

Scientific Name	Common Name	Parts Taken
Forbs (Cont.)		
Silene multicaulis		Flower heads
Veronica wormskjoldii	Alpine speedwell	Flower heads, little foliage
Woodsia sp.	Rock fern	Dried foliage
Xerophyllum tenax	Beargrass	Flower heads in summer, leaf foliage in winter
Grasses & Grasslike plants:		
Agropyron spicatum	Bluestem wheatgrass	Cured culms and foliage
Bromus tectorum	Downy chess	Green foliage
Calmagrostis rubescens	Pinegrass	Cured culms and foliage
Carex geyeri	Elk sedge	Green or cured foliage
Festuca idahoensis	Idaho fescue	Green culms in summer, cured culms in winter
Juncoides sp.		Green foliage
Juncus parryi		Green and cured foliage
Koeleria cristata	Junegrass	Cured culms and foliage
Poa alpina		Green culms and little foliage
Poa sp.	Bluegrass	Green culms, and cured culms and foliage
Shrubs:		
Acer glabrum	Mountain maple	Stems and buds
Amelanchier alnifolia	Serviceberry	Stems and buds
Ceanothus velutinus		Green foliage and stem tips in winter
Juniperus scopulorum	Rocky Mt. juniper	New stem tips
Philadelphus lewisii	Mockorange	Sucker shoots
Physocarpus malvaceous	Ninebark	Sucker shoots
Prunus demissa	Chokecherry	Stems and buds
Ribes sp.	Currant	Stem tips
Rosa sp.	Rose	Tips of sucker shoots
Salix sp.	Willow	Green foliage and stem tips in summer, stems and buds in winter
Symphoricarpos albus		Stem tips
Vaccinium membranaceum	Huckleberry	Green foliage
Vaccinium scoparium	Dwarf huckleberry	Green foliage and stems
Trees (in winter):		
Pinus ponderosa	Yellow pine	Needles
Pinus albicaulis	Whitebark pine	Needles, buds and new stem tips
Pseudotsuga taxifolia	Douglas fir	Needles, buds and new stem tips

Plant Species Found in Mountain Goat Habitat

Table 16 lists those species of plants identified as occurring in or near mountain goat habitat.

TABLE 16

PLANTS FOUND IN AND NEAR MOUNTAIN GOAT HABITAT OF WESTERN MONTANA

Scientific Name	Common Name
Trees:	
Abies lasiocarpa (Hook.) Nutt.	Alpine fir
Larix lyallii Parl.	Alpine larch
Larix occidentalis Nutt.	Western larch
Picea engelmannii (Parry) Engelm.	Engelman spruce
Pinus albicaulis Engelm.	Whitebark pine
Pinus contorta Dougl.	Lodgepole pine
Pinus ponderosa Dougl.	Ponderosa pine
Pseudotsuga taxifolia (Lamb) Britt.	Douglas fir
Shrubs:	
Acer glabrum Torr.	Mountain maple
Amelanchier alnifolia Nutt.	Serviceberry
Arctostaphylos uva-ursi (L.) Spreng.	Bearberry or kinnikinick
Artemisia diversiflora Rydb.	
Artemisia michauxiana Besser.	
Azaleastrum albiflorum	False azalea
Berberis repens Lindl.	Creeping hollygrape
Ceanothus velutinus Dougl.	Snowbrush
Cercocarpus ledifolius Nutt.	Mountain mahogany
Dasiophora fruticosa (L.) Rydb.	Shrubby cinquefoil
Holodiscus dumosus (Nutt.) Heller	Ocean spray
Juniperus scopulorum Sar.	Rocky Mountain juniper
Kalmia microphylla (Hook.) Heller	Rocky Mountain laurel
Ledum glandulosum Nutt.	Smooth labrador-tea
Menziesia glabella Grey	Menziesia
Pachystima myrsinites Raf.	Mountain lover
Philadelphus lewisii Pursh	Mockorange
Phyllodoce empetriformis (Smith) Don	Mountain heath
Physocarpus malvaceus (Torr.) A. Nels	Ninebark
Prunus demissa (Nutt.) Walp.	Chokecherry
Ribes sp.	Currant
Rosa sp.	Wild rose
Salix sp.	Willow
Sambucus melanocarpa Gray	Elderberry
Sorbus scopulina Greene	Mountain ash
Spiraea densiflora Nutt.	Pink meadowsweet
Spiraea lucida Dougl.	White meadowsweet
Symphoricarpos albus (L.) Blake	Snowberry
Vaccinium membranaceum Dougl .	Huckleberry

TABLE 16 (Continued)

Scientific Name	Common Name
Vaccinium scoparium Leiberg	Dwarf huckleberry
Grasses and Grass-like Plants:	
Agropyron saxicola (Scribn. & Smith) Piper	
Agropyron spicatum (Pursh) Scribn. & Smith	Bluebunch wheatgrass
Argostis hiemalis (Walt.) B.S.P.	Ticklegrass
Bromus inermis Leyss	Smooth brome
Bromus tectorum L.	Cheatgrass
Calamagrostis rubescens Buckl.	Pinegrass
Carex festivela	Ovalhead sedge
Carex geyeri Boott.	Elk sedge
Carex scopulorum Holm.	
Festuca idahoensis Elmer.	Idaho fescue or bluebunch fescue
Festuca ovina L.	Sheep fescue
Festuca scabrella Terr.	Rough fescue
Juncoides sp.	
Juncus parryi Engelm.	
Koeleria cristata (L.) Pers.	Junegrass
Oryzopsis exigua Thurb.	Little ricegrass
Phleum alpinum L.	Alpine timothy
Poa alpina L.	Alpine bluegrass
Poa epilis Scribn.	Skyline bluegrass
Poa secunda Presl.	Sandberg bluegrass
Sitanion hystrix (Nutt.) J. G. Smith	Squirrel tail
Herbs or Weeds:	
Achillea lanulosa Nutt.	Yarrow
Agoseris villosa Rydb.	False dandelion
Allium cernum Roth	Wild onion
Anaphalis margaritacea (L.) Benth. & Hook.	Pearly everlasting
Anemone tetonensis Porter	Alpine anemone
Angelica lyallii Wats.	Lyals angelica
Antennaria rosea (EAt.) Greene	Pussy toes
Arenaria formosa Fisch.	Grass sandwort
Arnica latifolia Bong.	Broadleaf arnica
Arnica longifolia Eat.	
Artemisia discolor Dougl.	Herbaceous sage
Aster sp.	
Astragalus sp.	
Campanula rotundifolia L.	Harebell
Castilleja sp.	Indian paint brush
Chamaenerion angustifolium (L.) Scop.	Firewood
Cirsium hookerianum Nutt.	White thistle
Dryas octopetala L.	White dryad
Drymocallis pseudorupestris	
Erigeron sp.	
Eriogonum depressum (Blankinship) Rydb.	Silver plant

TABLE 16 (Continued)

Scientific Name	Common Name
Herbs or Weeds (Cont.):	
Eriogonum subalpinum Greene	Umbrella plant
Eriogonum umbellatum Torr.	Sulphur plant
Eritrichium howardii (Gray) Rydb.	
Gayophytum racemosum Torr. & Gray	
Gentiana calycosa Griseb.	Blue gentian
Heuchera glabella Torr. & Gray	Alumroot
Hieracium scouleri Hook.	Hawkweed
Hypericum scouleri Hook.	Scouler's St. Johnswort
Mimulus lewisii Pursh.	Red monkey flower
Parnassia fimbriata Banks	Fringed parnassia
Pedicularis contorta	Alpine lousewort
Pedicularis groenlandica Retz.	Elephanthead
Pentstemon ellipticus Coult. & Fish	
Pentstemon sp.	
Phacelia leucophylla Torr.	White phacelia
Phacellia sericea (Graham) Gray	Silky phacelia
Potentilla filipes Rydb.	Snowy cinquefoil
Potentilla glaucophylla Lehm.	Blueleaf cinquefoil
Sedum stenopetalum Pursh.	Yellow stonecrop
Senecio pseudaureus Rydb.	
Senecio pursh[illegible]anus Nutt.	
Senecio triangularis Hook.	Arrowhead ragwort
Sieversia ciliata G.	Old mans whiskers
Silene multicaulis Nutt.	White catchfly
Valeriana scouleri Rydb.	Scouler valerian
Veratrum viride Ait.	False hellebore
Veronica wormskjoldii Roem. & Schult	Alpine speedwell
Xerophyllum tenax (Pursh.) Nutt.	Beargrass
Lichens, Mosses and Ferns:	
Lycopodium sp.	Club moss
Polytricum sp.	Moss
Woodsia sp.	Rock fern

WATER REQUIREMENTS

An abundance of water occurs on the high mountain ranges of Montana in the form of small springs coming either directly out of the ground, from the high boggy flats, or pockets, or from the many snow accumulations which last most of the summer. With this availability it was difficult to determine the actual water use and needs of goats.

While making the preliminary survey of mountain goats in the Continental Divide area in the summer of 1946 a tabulation, Table 17, was made of the distance of each goat from its nearest known water supply at the time it was first observed. Distances shown in Table 17 represent distances to known available water. Closer unknown sources of water may have been available in some cases.

TABLE 17

DISTANCE OF MOUNTAIN GOATS FROM NEAREST KNOWN WATER SUPPLY WHEN FIRST OBSERVED

(July, August and September, 1946. Flathead-Sun River area)

Distance (fraction of a mile)	Number of Mountain Goats
0-1/8	13
1/8	33
1/4	98
1/2	153
3/4	28
1 & over	12
Total	337

Most animals were seen at a half mile or less from a known water source. This may have been partly due to the fact that there are only few places in that entire area where one could be more than a half mile from some kind of water supply. It is doubtful that the availability of water has any effect on the local distribution of mountain goats in this region.

It is difficult to state just how frequently goats take water. They have been seen drinking during almost every period of the day with no tendency for favoring a particular period. Oftentimes when a group of goats came near to water while feeding, a few, but not all, would stop to drink. On several occasions goats were known to go without water for the largest part of a day.

One of the common sources of water used during the summer was snow from the banks which persist into July and August. Often during warm afternoons goats would eat snow for two or three minutes after a period of feeding and just before bedding down on the snow.

Goats show little reluctance to wading through shallow rivulets six or eight inches deep, and only occasionally jump over them. They have been known to wade up to about two feet of water to get to salt licks. It is

believed, however, that larger rivers and streams form natural barriers to goat movements and it would be exceptional if they attempted to swim. No mountain goats have been seen or reported swimming the larger streams. A group of goats which frequent the Little Salmon licks on the South Fork of Flathead have often been flanked on three sides by people and stopped on the fourth side by the South Fork River. Many people have gotten photographs of goats in this manner.

SALT USE AND REQUIREMENTS

Mountain goats are attracted to the many natural and artificial salt licks apparently as strongly as any other game species. Along with elk and deer, goats make common use of many of the natural licks and are known to make definite seasonal and daily migrations to eat the material in them. The furthest distance which goats have traveled to get to salt licks is not known. Natural licks are quite numerous in much of the goat habitat and a great many artificial licks have been established on the high ranges through the big game salting efforts of the United States Forest Service, and the Montana State Fish and Game Department. Owing to this availability it is doubtful that goats need to move more than five or ten miles from their common summer range to get minerals.

Many of the natural licks examined were associated with the blue and green outcroppings in the red shale formations of argillite and quartzite rock. It was thought that moist areas in these outcroppings made available a solution of either a rare mineral or high concentrations of a highly desirable mineral. Quick-test analyses were made of samples from two licks to determine, if possible, the principal cause of attraction to each of these licks. Results indicated a wide difference in the mineral available in the two licks. In both instances vital minerals were present which might be short in the animals' diet.

A quick-test analysis of a sample taken from the Little Salmon lick in the South Fork of Flathead River indicated the following constituents:

pH -- 8.0
235 parts per million of water-soluble salts, predominantly sodium chloride (NaCl).

Ions of:

Calcium (Ca) -- a trace
Sodium (Na) -- medium amount
Chlorine (Cl) -- medium amount
Magnesium (Mg)-- light to medium amount
Sulfates -- a trace

A concentration of 235 parts per million of soluble salts is not high normally. It likely would not be attractive unless the area in general was low in soluble salts and this was a source of higher concentration. Calcium controls the blood coagulation and aids bone formation. Sodium helps to regulate osmotic pressure and blood volume. Magnesium helps to regulate blood metabolism. It is plausible that any one or a combination of these may be deficient in the system of the animal during the spring.

A test of a sample from the Walton lick in Glacier National Park indicated:

pH -- 8.2
600 parts per million of water-soluble salts.
Phosphorus (P) -- very high.

Phosphorus may have been the chief attraction here. This element is

essential for animal nutrition. It is contained in the blood of mammals in both organic and inorganic forms. In the form of phosphates, it serves as buffers in the blood. In complex combinations, it functions in muscle contractions. The calcification of bone depends on the Ca/P ratio. Of the two-thirds of the bone's weight composed of inorganic matter, about 85 per cent is calcium phosphate. During the spring it is reasonable to believe that a goat's system could be lacking in this important element. Any concentrated source of supply such as available in the Walton lick might be a strong attraction.

There is little doubt but that the intense use of plain sodium chloride (NaCl) placed out in artificial licks demonstrates a mineral shortage in the animals' systems. There is a certain amount of satisfaction gained by the use of the salt in this concentrated form. A plausible theory expounded by some workers explaining the desire for sodium chloride is that plant structures store a high concentration of potassium and little sodium. When feeding on forage the excess of potassium may rob the body of sodium, calcium and magnesium. A supply of sodium chloride in the form of block salt would be a partial replacement of those deficiencies.

Another type of natural lick frequented by goats was the wallow-like hole in an earthen bank, usually fed by a slow seepage of water. Like elk which use these same licks a great deal, the goats waded around in the mire of the hole and licked at the moistened soil, drank some of the water or ate some of the dry soil from the sides of the bank. Animals spent hours in these licks and for days never ventured more than a quarter or a half mile away. The vegetation in the surrounding area was either trampled or eaten to a serious degree. Feces were abundant over the ground. It was thought that the heavy deposits of feces and urine in the lick itself made up a large part of the mineral solution used by the animals. Whether this accumulation was a part of the attraction of the lick or not was not known.

Most licks were used by more than one species of big game. When representatives of two or more species arrived at a lick at one time there was some fighting or sparring around to determine which species would satisfy their requirements first. In most all instances elk drove goats from a lick. This was observed many times. Often the goat was quite agressive and persistent, returning time and again only to be chased away each time. On some occasions elk were seen to be the only users of a lick while a group of goats was bedded down just a short distance from the lick. The goats would remain bedded until the elk had their fill and departed, then they would move in for their own requirements.

On the other hand, goats dominated deer at licks. Both nannies and billies were seen to be doggedly persistent in keeping deer away from a lick until their own wants were satisfied.

Little physical contact ever took place during these encounters. No physical injuries were ever noticed. Occasionally elk would rise up on their hind legs in warding off goats or other elk. Goats were never seen to make the fullest use of their main defensive weapons--their sharp horns. They seldom made any slashing or ripping gestures at the other animals. Their charges at deer usually consisted of a show of head-on butting, apparently

more in an attitude of bluffing. Several goats at the same lick displayed little intolerance for each other. If two animals were vying for the same small spot at which to feed, one animal would be forced to leave. Such encounters meant little or no actual fighting on the part of either animal.

NUMBERS AND DISTRIBUTION IN MONTANA

Historical Range and Numbers

Montana forms the southeastern limits of native mountain goat range in the Rocky Mountain chain. With the exception of recently introduced herds there is no evidence available to indicate that the range of mountain goats in Montana has varied considerably for many years. The earliest records available of numbers and distribution started in 1919. The United States Forest Service made estimates of mountain goats in their annual cumulative big game reports. A summary of these estimates from 1919 through 1942 is presented in Table 18 according to the National Forests in Montana. These estimates do not include Glacier National Park numbers.

No doubt discrepancies occur in these estimates and may account for most of the fluctuation which occurs. All the numbers are only estimates and are subject to variation with changes in personnel making the reports.

TABLE 18

CUMULATIVE MOUNTAIN GOAT ESTIMATES, 1919 THROUGH 1942

Year	Absaroka	Beaverhead	Bitterroot	Cabinet	Custer	Deer Lodge	Flathead	Helena	Kootenai	Lewis & Clark	Lolo	MONTANA
1919		125	729	250	6	200	515		805	675	148	3453
1920		108	379	445		115	1015		880	525	133	3600
1921		108	615	100		185	1075		5	460	630	3178
1922		286	590	150		275	416		5	480	480	2682
1923		210	522	200		269	610		15	490	164	2480
1924		452	912	225		353	537		50	500	225	3254
1925		471	1185	205		419	560		162	516	182	3700
1926		481	1388	185		537	600		262	520	275	4248
1927		513	1228	190		535	662		280	380	217	4005
1928		575	1138	245		569	642		180	505	228	4082
1929		597	1173	255		592	650		206	550	260	4283
1930		497	1120	275		606	695		121	610	272	4196
1931		555	1100	155		600	705		133	600	255	4103
1932		626	1110	230		551	685		140	600	278	4220
1933		631	1110	260		532	685		128	570	265	4181
1934		635	1125	175		502	700		168	600	285	4190
1935		650	695	380		496	800		176	550	245	3992
1936		675	695	200		472	835		141	450	227	3695
1937		650	700	200		400	850		100	400	200	3500
1938		600	700	200		350	1200		150	450	230	3880
1939		650	700	170		350	1200	10	150	450	250	3930
1940		680	700	200		300	1250	10	150	450	260	4000
1941	10	620	720	180		300	1300	10	150	450	260	4000
1942	15	620	700	240	15	280	1300	10	210	450	260	4100

In 1943 the Montana State Fish and Game Department started making estimates of big game numbers in the state. Table 19 shows the estimated numbers of mountain goats for Montana, by management units, from 1943 through 1948. These records do include numbers submitted for Glacier National Park by the National Park Service. For comparing totals in this table with totals in Table 18, a figure of approximately 850 should be added to the latter to account for the average number in Glacier Park.

Fluctuations occurring in these figures are probably partly due to unintentional discrepancies. Changes in personnel making the reports is probably the chief factor. The figures for 1947 are thought to be the most accurate estimates within both Table 18 and Table 19. They were made by trained personnel who visited most areas to check and co-ordinate reports.

TABLE 19

CUMULATIVE MOUNTAIN GOAT ESTIMATES, 1943 THROUGH 1948

Year	Beartooth	Big Belt-Boulder	Big Hole-Monida	Bitterroot	Bridger-Crazy Mts.	Choteau	Clark Fork	Deer Lodge	Ennis-Hebgen	Flathead-Sun River	Callatin	Kalispell	Kootenai	Polson	Swan-Blackfoot	Blackfeet Indian Res.	Glacier Park	MONTANA
1943	16		15	660	35		230	950		1390		170	175	200	380	10	960	5191
1944	15		12	670	50		225	990		1380		160	175	200	375	10	945	5207
1945	17	15	30	670	65	3	265	850		1385		180	125	200	390	6	981	5182
1946	6	15	30	670	75	3	285	835		1470		100	175	200	351	6	870	5055
1947	12	15	30	310	95	16	225	460		1800		100	125	75	315	10	866	4451
1948	6		30	575	110	4	50	665	2	1250	5	41	190	100	280	20	815	4143

These records of estimates are indicative of the need for a good standardized technique for determining numbers or trends in numbers. Past methods of censusing are valuable only to a limited degree. Close management of this big game species can be accomplished only after refined techniques for censusing have been brought about.

Present Range and Numbers

To facilitate discussion, herds are designated and discussed separately. They are distinguished according to their geographical location.

Native Herds

Northern Continental Divide Herd

TABLE 20

SUMMARY OF MOUNTAIN GOAT NUMBERS FOR THE NORTHERN CONTINENTAL DIVIDE HERD

Area	Adults Unclassified	Mature Males	Mature Females	Yearlings	Kids	Unclassified	Total Seen	Estimated Additional	Total
Sun River	22	4	7	6	7	11	57	183	240
Teton River	15	4	14	8	12	3	56	309	365
Middle Fork, Flathead	4	4		3			11	329	340
South Fork, Flathead									
Coram								100	100
Spotted Bear	32	17	10	5	9		73	227	300
Big Prairie	49	31	22	14	18	6	140	355	495
Swan River (east side)								50	50
Upper Blackfoot and Clearwater								100	100
Total	122	60	53	36	46	20	337	1653	1990

This is the largest and most widely distributed herd to be found in the state. The Continental Divide forms the backbone for this 470,000 acres of goat range. Outlying areas protrude from the Divide to the west and to the east. The headwaters of the South Fork and Middle Fork of the Flathead River, the headwaters of eastern tributaries to Swan River and the headwaters of the Clearwater and upper Blackfoot drainages are on the west side. The headwaters of Sun River and Teton River are on the east side of the Divide. Glacier National Park bounds the area on the north. The Blackfoot River bounds it on the south. The Bob Marshall Wilderness Area constitutes the most isolated portion of this area. Roads penetrate only a shallow border and the remainder is accessible only on horseback or on foot.

In 1946 a preliminary study was made of the goats in this herd. Most goat habitat in this region was visited. Detailed records were kept of life history and animal characteristics. Animal numbers were recorded by age and sex. Details of the various features of local habitat were also noted.

The range of this Continental Divide herd is indicated on the map in Figure 18. Table 20 summarizes the animals seen during the investigation with the estimated additional animals. More detailed estimates are shown in Table 22 of the state-wide numbers and distribution.

A total of 337 mountain goats were seen on the Northern Continental Divide Unit during this investigation. Additional estimates were made for each individual area visited and for those portions of the range not visited. Altogether it gives an estimate of 1,990 goats for the entire herd.

Of the animals seen, only 20 were not classified as to age or sex. Of the remaining 317 animals, 122 were adults but their sex could not be identified. Application of the male-female sex ratio of the identified adults to the 122 unclassified adults does not seem justified. Identification of females was most often possible because they had their young following them. Certain peculiarities made some of the males positively identifiable. It does not seem reasonable that the ratio of identifiable males to the females with young is applicable to those adults without such identifying characteristics.

On the basis of the 317 classified animals the following age and sex ratios were computed:

60 males : 50 females = 1.13 males : 1 female or 1 male : .88 females
36 yearlings : 46 kids = .78 yearlings : 1 kid or 1 yearling : 1.28 kids
235 adults : 46 kids = 5.11 adults : 1 kid or 1 adult : .196 kids
235 adults : 36 yearlings = 6.53 : 1 yearling or 1 adult : .53 yearlings

Expansion of these ratios to apply to the entire herd indicated the following herd composition:

TABLE 21

HERD COMPOSITION OF THE NORTHERN CONTINENTAL DIVIDE HERD

	Observed and Classified	Per Cent	In Total Herd
Adults	235	74.1	1474
Yearlings	36	11.4	227
Kids	46	14.5	289
Total	317	100.0	1990

There has been limited hunting of goats in parts of this unit. Yearly fluctuations in estimated numbers, though, have been no more apparent during seasons of hunting than during seasons when there was no hunting. Concentration of hunting has kept numbers down in a few localized areas. However, it is believed that goats from areas of no hunting replace many of those being taken. It is doubtful that the hunting pressure in the past has had any serious effect on the numbers for the unit as a whole. Continued limited hunting should not be injurious to the herd.

Glacier National Park Herd

The goats in Glacier National Park are not entirely isolated from the animals in the Middle Fork of Flathead south of the Park nor from those animals to the north in Waterton National Park of Canada. Some natural drifting between these areas occurs but it is not great and the Glacier Park herd may be treated as a single unit. Goat range covers approximately 300,000 acres in the Park.

Glacier Park officials reported approximately 866 mountain goats in 1947. At the heads of Milk and Mary Rivers on the Blackfeet Indian Reservation was a small herd of approximately 10 goats. These were outside the Park boundary but were considered as a part of the Park herd.

The numbers and ranges of mountain goats in the Park have been kept approximately static since about 1932 by predators and winter losses.

Mission Range Herd

At 7,000 to 10,000 feet the rugged peaks of the Mission Range east of Polson furnish approximately 53,000 acres of excellent mountain goat habitat. The main portion of this habitat centers around Gray Wolf Peak. It extends north to Gold Creek on the Swan side and to the head of Crow Creek on the Flathead side of the range.

A ten-day study of this area was made by two state biologists in August, 1947. In the Gray Wolf Peak and High Park Lake country, they found 19 unclassified adults, 5 mature males, 6 mature females, 3 yearlings and 5 kids, or a total of 38 goats. An additional 162 goats were estimated to be in the herd.

This entire range, and particularly the west side, has been subjected

FLATHEAD LAKE

Figure 18

Mountain Goat Range
of the
Northern Continental Divide Herd

to unrestricted year-around hunting by the Flathead Indians whose reservation includes the west slope of the Mission Range. At one time this drain was considerable and caused an appreciable decrease in numbers, but in the past few years numbers have been stabilized. The present stocking rate appeared to be lower than proper stocking would allow.

Whitefish Range Herd

This is a small herd ranging at the headwaters of the western tributaries of the North Fork of the Flathead River. This herd of an estimated 50 animals is divided among three localities: First is Mount Thompson, Hornet Mountain and Cliff Rock Mountain, between Yakinikak and Whale Creeks. The second is Nasukoin and Whitefish Mountains and Mount Young at the head of Whale and Red Meadow Creeks, and the third is Smoky Range between Big Creek and Canyon Creek. The total goat range in these units totals about 21,000 acres.

Because of their inaccessibility, goats are seldom seen on any of these ranges. The best information regarding this herd has come from Forest Service personnel. They report that there has been no appreciable increase of numbers in the past ten years. Since 1938, their estimates have been 40 to 50 head. The most recent estimate available was 50 goats in 1947.

Cabinet-Kootenai Herd

The Cabinet Range between the Kootenai River and the Clark Fork River in northwest Montana supports the bulk of this herd. There are approximately 105,000 acres of goat range in this area. It starts just west of Libby and extends southeast to the West Fork of the Thompson River. The core of this herd is in and around "A" Peak and the North Fork of Bull River. In addition, there is a small range of about 3,000 acres at the head of Trout Creek near the Montana-Idaho divide on the west side of the Clark Fork River.

State men made a limited trip into the Cabinet Range from the Kootenai side and made observations in the vicinity of "A" Peak, Snowshoe Creek, Cherry Creek and Carney Peak in the summer of 1947. They saw 2 unclassified adults, 3 mature males, 4 mature females and 3 kids, or a total of 12 goats. This was not a satisfactory count on which to base an estimate of the entire herd. Other reliable information lead to an estimate of 305 goats in the Cabinet Range and 45 on the Montana-Idaho divide, or a total of 350 for the entire herd. Forest Service employees reported having seen 75 animals in the North Fork headwaters of Bull River during a recent fall. Also other employees had seen 10 goats on Billiard Table Mountain in 1947, and 14 on Windfall Peak in Trout Creek.

The best historical information available suggests that this herd has been decreasing during the last 20 years. It is probably a remnant of a larger herd that ranged further than at present, but was still centered in the Cabinet range.

Rattlesnake Herd

This herd of an estimated 25 animals ranges at the headwaters of Rattlesnake Creek just north of Missoula. There are approximately 14,000 acres of

range utilized here by goats. Mosquito Peak and Stuart Peak areas make up the summer range. The lower range of cliffs near Franklin Ranger Station furnishes winter range. According to the best information available this herd has remained nearly static in numbers for the past few years.

Bitterroot Herd

The Bitterroot Range forms part of the Montana-Idaho boundary southwest of Missoula. On the Montana side there are approximately 347,000 acres of mountain goat habitat extending from Lolo Peak south to the Nez Perce Fork of the Bitterroot. There is also a small area of about 10,000 acres on Piquett Mountain between the East Fork and West Fork of the Bitterroot which is also included in this range.

High basins, ridge spurs and cliff walls are numerous throughout the 20 major canyons which make up the drainage system for the east side of this range. Such features of the terrain make this area most difficult to census mountain goats by ground coverage. An extensive aerial check was therefore made of the Bitterroot goats in September, 1947. The returns of 9 hours and 15 minutes flying time yielded returns estimated to equal from 45 to 60 man-days, plus horses, of ground work.

Flights were made into 17 canyons and 111 goats were counted. It was extremely difficult to distinguish sexes from the air except in case of a nanny with a kid. Of the 111 animals seen, 101 were adults unclassified as to sex, 5 were females and 5 were kids. An estimate of the number in the entire Bitterroot herd was conservatively set at 310, including 5 head in the isolated Piquett mountain area.

The Forest Service estimated 1,100 goats in the Bitterroots in 1932 and 1933. The State Fish and Game Department estimated 670 in 1945. These estimates may have been rough, but even with allowance for a large error, they attest to a definite downward trend in numbers.

Goats in this range have been subjected to hunting each year from 1929 through 1947. It is evident now that the base herd has not been as large in recent years as reported. It was not high enough to support the annual kill of 45 to 50 goats which were known to be taken each year from 1944 through 1947. A winter loss can be expected in any mountain goat herd. With the added burden of a large hunter take, such as that in the Bitterroot, injury to the herd does occur. The Bitterroot herd has been on the decrease and a relief from the hunting pressure should help restore former numbers.

Beaverhead Herd

Range for this herd is also on the Montana-Idaho line west of Dillon. This is also a portion of the Continental Divide. On the Montana side there are approximately 40,000 acres of goat range extending from the headwaters of Darkhorse Creek north to Moose Creek and Pyramid Peak. This range is restricted closely to the crest of the divide.

Only 4 goats were seen in this territory in 1947. There was good evidence though, that a herd of approximately 30 head resided there and that it has been stabilized at about that number for years.

Pioneer Mountain Herd

The main range for this herd lies between Wise River and the Big Hole River about 25 miles southwest of Butte near the headwaters of Canyon and Rattlesnake Creeks. The country contains many high lakes and basins. In addition, there are two small isolated bits of range, one on Foolhen Mountain and the other on Odell Mountain, on the west side of Wise River. Approximately 67,000 acres make up this total range which supports an estimated 200 mountain goats.

Complete information as to the status of this herd is lacking except the evidence suggested by the fact that goats appeared only recently on Foolhen Mountain. Expansion to this new range may indicate an increase of numbers in the mother herd.

Pintlar Peaks Herd

The range of this herd is also centered along the Continental Divide where the headwaters of the East Fork of the Bitterroot River, Rock Creek and Big Hole River all come together about 20 miles southwest of Anaconda. Most goats were found in the range around Pintlar Peaks from which radiate the three divides between the above mentioned drainages. On about 66,000 acres of goat range in this range there was estimated to be 135 animals. Indications were that the herd was slightly decreasing or near static at a number lower than this habitat appeared capable of supporting.

Flint Creek Herd

The Flint Creek Range, between Deer Lodge and Philipsburg, furnishes approximately 60,000 acres of goat habitat. This range is situated in the headwaters of Boulder Creek draining north and Rock, Tincup, Dempsey, Racetrack, Modesty and Lost Creeks flowing east. Of the 125 mountain goats estimated to be on this range over half were reported to remain in the Lost Creek drainage most of the time.

Information on the status of this herd was not complete, but the most reliable reports indicate that numbers were increasing slightly. Habitat available on this range should support a larger herd than is there at present.

Pipestone Herd

About 5,000 acres of the Continental Divide in the head of Pipestone Creek approximately 15 miles southeast of Butte supports a small herd of goats estimated to be 15 head. These animals were seen only occasionally and complete information regarding their range and status was not available. However, indications were that the herd was not increasing satisfactorily. The available habitat should allow for greater numbers.

Introduced Herds

One method of increasing the number of game animals is by extending their range. Native mountain goats in Montana have been restricted to

isolated habitats near the Continental Divide and their expansion into new ranges has been almost negligible. Many other areas in the state appear to have favorable range conditions for mountain goats. The State Fish and Game Department has been carrying on a program of live trapping and transplanting mountain goats since 1941 for the purpose of stocking some new areas with this big game species.

As a part of the 1947 censusing program, the areas where goats had been introduced were checked to determine whether the planted stock had developed a newly established herd. Information regarding the feasibility or necessity of additional plantings and the status of each of these transplanted herds is discussed here by areas.

Crazy Mountains Herd

The Crazy Mountains north of Livingston and Big Timber are separated from the Rocky Mountain chain by wide and low valleys. They apparently afford excellent habitat into which goats have never migrated. This area was selected for the earliest stocking program. Ten goats were introduced there in 1941. An additional eleven goats were introduced in 1943. The isolation of this range affords an excellent opportunity to observe the development of a transplanted herd. The resulting herd establishment to date has been gratifying. Many interesting and helpful reports have come from people residing in the area ever since the transplants were made.

Early in September, 1947, three State Department employees made a check of the area and contacted local residents to determine the status of the herd. In the field they saw only 8 goats, 4 unclassified adults, 2 adult males, 1 mature female and 1 kid. Five of these were seen in Sweet Grass Creek and 3 in Milly Creek.

Residents have reported that they frequently have seen a group of 25 goats on Milly Creek during the spring of 1947.

On the basis of all reports, the herd was estimated to be about 95 animals. Apparently the goats were adaptable to this new range. The size of the herd has definitely increased in this environment.

Seldom have the goats moved more than 5 or 6 miles from their point of release and most of them are now in the Milly Creek area. Of about 43,000 acres available as good range, there are still parts that are not inhabited by numbers equal to their carrying capacity. Further expansion of the herd may be expected.

A billy was reported seen on the prairie 15 miles from the point of release, but this was believed exceptional.

Beartooth Plateau Herd

Mountain goats have been transplanted into two areas in the Beartooth Plateau Range south and east of Livingston and west of Red Lodge.

Twelve goats were released on the South Fork of Rock Creek in 1942.

These animals have seldom been seen. The few times they have been reported assures us there is still a herd there with possibly a slight increase in numbers. Nine animals were seen on the South Fork of Rock Creek in June, 1947. Some of these were kids. Twelve to 15 from this herd have been reported across the state line on Little Rocky Creek of the Shoshone National Forest of Wyoming. The original plant is not yet well established as a herd. The animals have not been seen regularly in any one locality so their range cannot be definitely described.

Further west, the headwaters of the Stillwater River were selected for additional plants. Two goats were released there in 1945 and seven in 1946. The two animals released in 1945 were seen later in the same year in Stillwater Canyon but have not been seen since. Of the seven released in 1946, a male and a female were known to have died later in the year. These plants were too recent to judge their success. It is felt that additional animals added to the original plant might insure establishment of a herd.

Highwood Mountains Herd

Square Butte, Round Butte and the Highwood Mountains are located about 25 miles east of Great Falls. A limited amount of habitat here should sustain a small goat herd. In 1943 four goats were released on Square Butte. Even this small number of animals has increased in the area. The Deputy Game Warden has reported seeing three goats on the North Fork of Highwood Creek in November, 1947. He has also seen some on both Square Butte and Round Butte. Sixteen animals were estimated in this herd.

Distribution of these animals was such that their range could not be well defined.

Gallatin Herd

In May, 1947, five goats were released in the Spanish Peaks at the head of the West Fork of the Gallatin River, approximately 40 miles north of Bozeman. This rugged range appeared to be excellent mountain goat habitat. State Department personnel checked the area later in 1947 and early in 1948 but were unable to locate the animals. In the summer of 1948, two goats were reported seen near the head of Bear Creek on the Madison drainage. This is 10 to 15 miles south of where the goats were released and entirely out of the Spanish Peaks area.

This plant was made too recently to judge its success in establishing a herd. A greater number of animals originally released or an additional number introduced soon should insure better establishment of a herd in this area.

Table 22 gives a detailed list of the location of estimated goat numbers in Montana as of 1947. The distribution of these numbers is illustrated by the map in Figure 19.

TABLE 22

ESTIMATED MOUNTAIN GOAT NUMBERS AND DISTRIBUTION IN MONTANA

Area	Specific Location	Estimated Number of Goats	
	Northern Continental Divide Herd		
Sun River	Continental Divide - Cliff Mt. to Molly Creek Pass	30	
	Slategoat - Prairie Reef	15	
	Castle Reef	18	
	Red Butte	43	
	Nineteen Mile Creek	6	
	Pearl and Ahorn Basins and Hoadly Reef	25	
	Sugarloaf Mountain	7	
	Triple Divide	15	
	Scapegoat Mountain	16	
	Sawtooth Mountain	15	
	Redslide Mountain	5	
	Crown Mountain	30	
	Steamboat Mountain	15	
Total for Sun River			240
Teton River	Chinese Wall	50	
	Moose Creek Ridge	15	
	My Lake	5	
	Three Sisters Peaks	30	
	Lookout Mountain	10	
	Moonlight Peak	23	
	Signal Mountain	15	
	Wrong Ridge	10	
	Mount Wright	22	
	Mount Drewyer	10	
	Mount Richmond	10	
	Scarface Mountain	10	
	Spotted Eagle Mountain	10	
	Goat Mountain	15	
	Blackleaf Creek	10	
	Choteau Mountain	15	
	Old Baldy	10	
	Rocky Mountain	43	
	South Fork, Deep Creek	52	
Total for Teton River			365
Middle Fork of Flathead River (Schafer Dist.)	Circus, Baptiste & Red Sky Mountains	30	
	Forester-Bradley Mountains	20	
	Horshoe, Twin & Hematite Mountains	20	
	Elk Calf-Big Lodge Mountains	65	
	Soakem, Capitol and Union Mountains	20	
	Argosy Mountain	10	
	Pentagon, Trilobite, Chair & Ringer Mts.	55	

TABLE 22 (Continued)

Area	Specific Location	Estimated Number of Goats	
Middle Fork of Flathead River (Schafer Dist.) -Cont.-	Angle Point to Teton Pass	40	
	Bowl Mountain to Muskrat Pass	80	
	Total for Middle Fork of Flathead River		340
South Fork of Flathead River (Coram Dist.)	Great Northern Mountain	55	
	Circus Peak to Felix Peak	20	
	Six Mile to Doris Mountain	12	
	Three Eagle to Big Hawk Mountain	13	
	Sub-total for Coram District	100	
(Spotted Bear District)	Six Mile Mt. to Thunderbolt Mt.	10	
	Gildart Peak to Thunderbolt Mt. (Crevice Lakes)	25	
	Inspiration Point and Alcove Mountain	27	
	Sunburst and Olar Lakes	20	
	Bunker Mountain	10	
	Beacon Mountain	6	
	Condon Peak	5	
	Whitcomb Peak	5	
	Spotted Bear Mountain to Meadow Mountain	45	
	Sergeant Mountain and Limestone Wall	16	
	Silvertip, Black Bear, Mid and Cathedral Mountains and Wall Creek Cliffs	70	
	Lone Butte, Pagoda and Turtle Head Mountains	32	
	Table Mountain to Kevan Mountain	22	
	Bungalow Mountain	7	
	Sub-total for Spotted Bear District	300	
(Big Prairie District)	Flathead Alps	35	
	Bullet Nose Mountain	11	
	Scarface Mountain	18	
	Apex, Pinacle and Tour Mountains	35	
	Jumbo and Woodtick Mountains	10	
	Monture Mountain to Pyramid Mountain	16	
	Crimson and Leota Peaks	30	
	Puma, Goat and Count Mountains	45	
	Sunday Mountain	13	
	George and Hessler Lakes	40	
	Gordon and Kid Mountains	26	
	Shaw Mountain	6	
	Gordon Pass to Holland Peak	32	
	Albino and Sappho Creeks	35	
	Gyp Mountain to Lena Mountain	16	
	Garnet Peak	12	

TABLE 22 (Continued)

Area	Specific Location	Estimated Number of Goats	
(Big Prairie District) -Cont.-	Charlotte Peak	20	
	Oreamus Peak to Stadium Peak and Point 56	45	
	Sub-total for Big Prairie District	445	
	Total for South Fork of Flathead River		845
Swan River Drainage	Doris Mountain to Six Mile Mountain	10	
	Six Mile Mountain to Thunderbolt Mountain	10	
	Thunderbolt and Swan Peaks and Goat Creek	30	
	Van Lookout, Lion Creek and Smith Creek headwaters	50	
	Total for Swan River drainage		100
Clearwater and Upper Blackfoot Rivers	Clearwater Lake to Pyramid Pass	20	
	Morrell Mountain	20	
	Monahan, Moser and Young Mountains	30	
	Triple Divide and Scapegoat Mountain	20	
	Lake Mountain	10	
	Total for Clearwater and Upper Blackfoot Rivers		100
	Total for Northern Continental Divide Herd		1990

Mission Range Herd

Swan River Drainage	Panoramic Peak to Hemlock Lookout	50	
	Mountaineer Lake to Turquoise Lake	25	
	Grey Wolf Lake and High Park Lake	50	
	Total for Swan River Drainage		125
Flathead River Drainage (Flathead Indian Reservation)	Grey Wolf Peak	25	
	Mission Creek	25	
	McDonald Peak	25	
	Total for Flathead River drainage		75
	Total for Mission Range Herd		200

Glacier National Park Herd

Glacier National Park	Entire Park	866	
Blackfeet Indian Reservation	Milk Creek and Mary Creek headwaters	10	
	Total for Glacier National Park Herd		876

TABLE 22 (Continued)

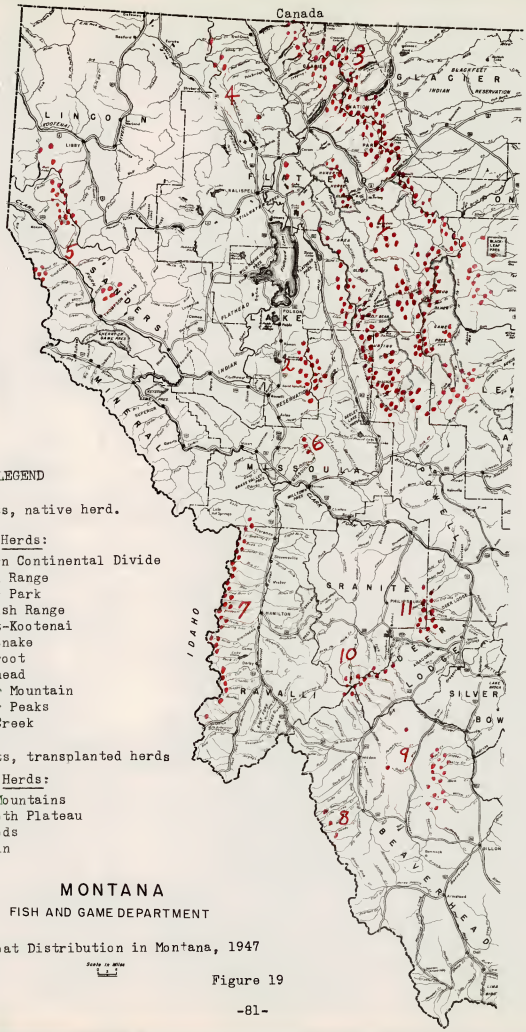
Area	Specific Location	Estimated Number of Goats
Whitefish Range Herd		
North Fork of Flathead River	Smoky Mountain	5
	Red Meadow and Link Lakes	10
	Lake Mountain and Nasukoin Mountain	15
	Mount Young	5
	Mount Thompson and Seton Mountain	5
	Wedge Mountain	5
	Cleft Rock	5
Total for Whitefish Range Herd		50
Cabinet - Kootenai Herd		
Troy	Spar Peak	15
	Billiard Table	20
Libby	Sky, Minor and Cedar Lakes	15
	Granite Lake to Leigh Lake	25
	Snowshoe Creek and Cherry Creek headwaters	20
	Libby Creek	25
	West Fisher River headwaters	25
Noxon	North Fork Bull River	25
	Middle Fork Bull River	20
	East Fork Bull River	20
	East Fork Rock Creek	20
	Goat Ridge	25
Thompson Falls	Cube Iron Mountain	40
	Mount Headley, Marmot Peak and Priscilla Peak	10
Trout Creek (West side Clark Fork River)	East Fork Trout Creek (Windfall Peak)	35
	Little Trout Creek	10
Total for Cabinet-Kootenai Herd		350
Rattlesnake Herd		
Missoula	Rattlesnake drainage (Mosquito & Stuart Peaks)	25
Total for Rattlesnake Herd		25
Bitterroot Herd		
Stevensville	Lolo Peak	5
	One Horse Creek	15
	Sweeney Creek	10
	Bass Creek	16
	Kootenai Creek	15

TABLE 22 (Continued)

Area	Specific Location	Estimated Number of Goats
Stevensville -Cont.-	St. Mary's Peak	18
	Big Creek	15
Hamilton	Bear Creek	15
	Fred Burr Creek	10
	Sheafman Creek	8
	Mill Creek	18
	Blodgett Creek	35
	Canyon Creek	5
	Sawtooth Creek	15
	Roaring Lion Creek	15
	Lost Horse Creek	10
	South Fork Lost Horse Creek	15
Darby	Rock Creek	15
	Tincup Creek	10
	Chaffin Creek	10
	Trapper Creek	15
	Boulder Creek	10
	Nezperce Fork	10
	Piquett Peak	5
Total for Bitterroot Herd		315
	Beaverhead Herd	
Goldstone Peak to Pyramid Peak		30
Total for Beaverhead Herd		30
	Pioneer Mountain Herd	
Wise River	Canyon and Trapper Creeks	75
	Rock Creek	15
	Willow Creek	15
	Birch Creek	25
	Rattlesnake Creek	50
	Foolhen Mountain	10
	Odell Mountain	10
Total for Pioneer Mountain Herd		200
	Pintlar Peaks Herd	
Big Hole-Bitterroot Divide	Pintlar Peaks	75
	Fishtrap Creek	20
	LeMarche Creek	20
	Seymour Creek	10
	Deep Creek	10
Total for Pintlar Peaks Herd		135

TABLE 22 (Continued)

Area	Specific Location	Estimated Number of Goats	
	Flint Creek Herd		
Anaconda, Philipsburg and Deer Lodge	Rock and Dempsey Creeks	25	
	Racetrack Creek	25	
	Lost Creek	75	
Total for Flint Creek Herd			125
	Pipestone Herd		
Butte	Pipestone Creek	15	
Total for Pipestone Herd			15
	Crazy Mountains Herd		
Livingston	Middle Fork Sweetgrass Creek	5	
	North Fork Sweetgrass Creek	10	
	South Fork Sweetgrass Creek	10	
	Miners and Blackaby Creeks	25	
	Lebo and Loco Peaks	10	
	Bruin and Cascade Creeks	10	
	Milly Creek	25	
Total for Crazy Mountains Herd			95
	Beartooth Plateau Herds		
Absaroka Forest, Columbus	South Fork Rock Creek (including 12 migrating back and forth into Wyoming)	22	
	Stillwater Creek	2	
Total for Beartooth Plateau Herds			24
	Highwood Mountains Herd		
Great Falls	Square Butte	5	
	Round Butte	6	
	Highwood Mountains	5	
Total for Highwood Mountains Herd			16
	Gallatin Herd		
Gallatin-Madison Divide	Spanish Peaks	5	
Total for Gallatin Herds			5
GRAND TOTAL FOR MONTANA			4451



LEGEND

• = 10 goats, native herd.

Herds:

1 Northern Continental Divide
2 Mission Range
3 Glacier Park
4 Whitefish Range
5 Cabinet-Kootenai
6 Rattlesnake
7 Bitterroot
8 Beaverhead
9 Pioneer Mountain
10 Pintlar Peaks
11 Flint Creek

X = 10 goats, transplanted herds

Herds:

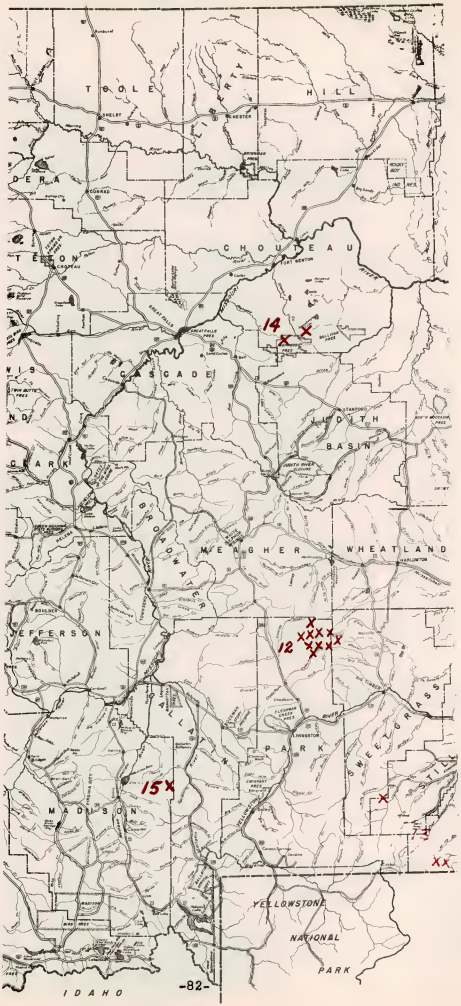
12 Crazy Mountains
13 Beartooth Plateau
14 Highwoods
15 Gallatin

MONTANA

FISH AND GAME DEPARTMENT

Mountain Goat Distribution in Montana, 1947

Figure 19


TOOLE
HILL
CHOUTEAU
CASCADE
LEWIS
CLARK
BROADWATER
WHEATLAND
JEFFERSON
GALLATIN
PARK
MADISON
SWEETGRASS
YELLOWSTONE
NATIONAL
PARK
IDAHO
14
12
15

DECIMATING FACTORS INFLUENCING POPULATIONS

It is believed that mountain goats suffer the greatest natural loss per capita of any species in this state. If this natural loss were less, a larger hunter take could be enjoyed from the present goat herds and a sustained or increased population would still be realized. Many factors contribute to the high natural loss. A better understanding of some factors should lead to management controls which would cut down these losses.

During this study evidence has been collected for various causes of natural losses. There are some indications of their relative importance. These findings are only preliminary. Further specific studies are seriously needed on this phase.

Evidence of Mortality

In the discussion of each herd in this state it was almost consistently stated that herds were either static or decreasing in numbers, even in the absence of hunting. This indicated a loss equal to or greater than the reproduction rate. The heaviest loss apparently came before the animals were a year old. Most of this loss no doubt occurred in the winter.

Of 317 animals identified in the preliminary study of the Continental Divide Unit, 46 kids were seen and only 36 yearlings. During the intensive summer study in the Red Butte area in the summer of 1947 four yearlings were the most seen during any thorough check. Fourteen kids were known to be in the herd that summer. The following spring only six yearlings were seen and two carcasses found were yearlings. In Washington, Anderson (1940) had even a greater kid-yearling difference. He identified 454 animals including 116 kids and only 19 yearlings. These figures indicate a 20 to 80 per cent mortality in goats between time of birth and one year old. It does not include pregancy losses nor losses at or immediately following birth.

Carcasses of two old billies were found in the Bitterroots. Age was indicated in one animal by a loss of seven incisors and molars worn down to the gums. A carcass of an aged nanny, numbered "23" in the early part of this report was found in the Rattlesnake. All three animals were winter losses. An aged billy was shot on Jumbo Mountain in the fall of 1947 and another near the head of Camp Creek. The condition of their teeth identified both as extremely old. Apparently many of the goats that live to be more than one year old live to old age. In these cases, losses would be due to complications from senility.

Most all natural losses which occurred in any age group came during the winter. Remains of the dead animals were usually found early in the spring. A summer inspection of a goat range seldom revealed evidence of goat mortality. Losses during the winter were usually attributable to complications arising from adverse weather conditions. Malnutrition or starvation, predators, diseases, parasites and accidents were usually the direct causes.

A shortage of winter feed and the adverse conditions for obtaining this feed were prevalent on most winter goat ranges. Such conditions surely were detrimental to the animals' health. Loss of weight, a loss of strength and a

lowering of the body resistance would result during each winter season. In this physical condition the animals would be easier prey to predators, diseases, parasites and accidents.

The carcass of the aged nanny (Figure 20) found in the Rattlesnake on January 15, 1948, indicated the animal had been in an advanced weakened condition from malnutrition. It was thought she slipped off the large ice flow pictured in Figure 20.

Remains of two carcasses were found in Chaffin Creek of the Bitterroots. Judging from the poor condition of the teeth the animals must have had serious trouble in feeding normally during the adverse winter conditions. It seemed probable that they suffered from malnutrition and that this could have been the direct cause of death.

Figure 20

Finding a Winterkill

Carcass of Aged Nanny in the Rattlesnake Drainage, January 15, 1948.

Predators

Physical features of mountain goat habitat aided considerably as a seclusion from many of their natural enemies. Although coyotes, bear and mountain lion were found in the same general habitat as goats they seldom have been observed on the narrow ledges within the rugged cliffy terrain. During the summer goats have been observed retreating to such ledges at the approach of bears, coyotes or humans. Thus far there have been comparatively few predator losses known to occur during the summer season. When winter came masses of ice and snow seriously reduced the accessibility of these cliffs and ledges. These same factors reduced the mobility of the animal. This placed the goat at more mercy to predators at that time of the year.

It is difficult to measure the full effect of predators on a mountain goat population. The following discussion is of some examples of predation that were known to influence the status of goat populations. They indicate a necessity for consideration of predators in mountain goat management.

Coyote

This predator was present in all mountain goat range of Montana. Because of the remoteness of most goat habitat artifical coyote control measures have had little or no effect on coyotes in those areas.

During the months of May and June, coyotes have been seen running the high ridges within mountain goat range. They have been observed standing on a point or on the edge of a snow cornice for periods of 15 to 30 minutes looking over the vast country within view. Most estival rodents of the high country were still in hibernation at that time. It was believed that coyotes were scavenging on big game carrion and possibly weakened animals.

During the last week in May and the first week in June, 1948, forty-nine samples of coyote scats were collected in the Red Butte area of Sun River. These were analyzed and the results are shown in Table 23.

TABLE 23

CONTENTS OF COYOTE SCATS COLLECTED IN MOUNTAIN GOAT HABITAT

Materials Identified	No. of Scats in Which Found	Per Cent of Occurence
Oreamnos americana (mountain goat)	9	18
Odocoileus sp. (deer)	15	31
Cervus canadensis (elk)	1	2
Lepus sp. (snowshoe rabbit)	2	4
Sylvilagus sp. (cottontail rabbit)	17	35
Sciurus sp. (squirrel)	6	12
Citellus sp. (ground squirrel)	2	4
Eutamius sp. (chipmunk)	1	2
Microtus sp. (mice)	3	6
Unidentified large mammel	2	4
Unidentified gallinaceous bird (grouse)	2	4
Dirt	1	2

Of the 49 samples analyzed, nine contained parts of mountain goats. This is not necessarily evidence of predation. It does indicate that a coyote's diet in the spring may include mountain goat, either as carrion material or predation kills. Six of eight goat carcasses found during the winter of 1947-48 in the Bitterroot and Red Butte areas showed evidence of having been eaten by coyotes. There was no evidence in any of these cases to indicate that death was due to predation.

Goat behavior at times suggested that at least the younger animals could fall prey to coyotes. Whenever a group of goats were disturbed seriously by observers some of the young animals would become separated from their mothers. The young would appear frantic in their efforts to locate their mothers. They would run around from one adult animal to another seeking out their mothers and would bleat loudly all the time. If coyotes should cause the same amount of disturbance in a group of goats, those lost young could become easy prey.

On one occasion a single coyote was observed to cause some disturbance in a group of 29 goats. The coyote was about 200 feet from the group before the goats apparently sighted it. Immediately all the goats retreated to nearby ledges and watched the coyote until it was out of sight. The coyote displayed no aggressiveness toward the goats. It appeared though, that the coyote could easily have scattered that group of goats into complete confusion.

Figure 21

A Group of Mountain Goats Alerted by a Coyote

Bear

Both grizzly bears and black bears were present in most goat habitat. Grizzlies were quite prevalent in the Continental Divide Unit. No direct evidence of bear predation was found in this study. None of the many bear feces

examined in the field contained goat hair.

A Forest Service Ranger from the Big Prairie District in the South Fork of the Flathead River reported that he came upon a goat and grizzly bear feeding within about 75 feet of each other on Kid Mountain. He was not much further than that from either animal when observing them. For some time he watched both animals continue to feed. Apparently each animal was oblivious of the other's presence.

A grizzly was known to eat the cleanings from a freshly killed goat on Crimson Peak in the South Fork of the Flathead.

These observations do not eliminate the possibility that bears of either species may at some time prey on mountain goats.

Mountain Lion

Within the past six to eight years the number of mountain lions in Western Montana has increased noticeably. Their habits suggest that they may occasionally prey on mountain goats. On December 31, 1947, observers found fresh lion tracks in Indian Creek, just south of Red Butte in the Sun River country. Twenty-four mountain goats were seen that same day within a mile of the lion tracks. No other big game was present for at least four miles. Tracks indicated that the lion had come even closer to the goats about 24 hours previously. The significance of the lion's presence here was not known, only suggestive.

Stomachs of thirteen mountain lions were analyzed by Maloit (1949). These animals were taken from Western Montana and some of them from near mountain goat habitat. He found no evidence of mountain goat in any of these stomachs.

Wolverine

Only an occasional wolverine was ever seen in Montana, and those were mostly in the Flathead-Sun River country of the Continental Divide Unit. In the winter of 1946-47 a member of a big game study crew scared a wolverine from a goat carcass just east of Big Prairie Ranger Station. It could not be determined whether the wolverine killed the animal or was just feeding on the carrion.

Eagles

Both the golden eagle and the bald eagle were considered major predators on mountain goats in Montana. Instances of actual predation have been seen by personnel of this study and reported to them on other occasions.

Probably the outstanding offender was the golden eagle which occurs commonly throughout most of Montana. Golden eagles were sighted almost daily during the summer portions of this study. They were present in the winter but not nearly so numerous. On many occasions nannies with kids were seen alerted by the presence of an eagle flying at close range. If the animals were bedded down they would rise and the nanny would watch the eagle closely until it was out of sight. She would usually stand close or right over her kid during the eagle's presence.

An employee of the Forest Service has photographed a golden eagle carrying away a young kid and the mother goat standing on her hind legs striking at the bird. Anderson (1940) in Washington reports having seen an eagle knock a yearling goat off a cliff when diving at it. The yearling landed on a ledge ten feet below with no ill effects. He reported another instance in which an eagle struck at a billy by diving at it. In both cases he thought the eagles were intentionally trying to knock the animals from the ledges rather than pick them up. On two different occasions in Montana observers have seen two eagles diving one right after the other at a single goat. On two other occasions goats were seen to move from cliffs to an open ridge when eagles dived at them. About ten years ago a golden eagle's nest was reported from the Pintlar Peaks area which had a considerable amount of goat hair strewn around it.

Not nearly as abundant in this state is the bald eagle. This bird is usually found nearer large bodies of water or larger rivers.

On the afternoon of June 3, 1948, a bald eagle was seen by two observers to carry a young kid from its mother. This incident occurred in the Red Butte area of Sun River. The following account from the field notes of the observers describes the incident: "At 4:15 a bald eagle was seen circling around some cliffs on which two nannies, two kids and a yearling were feeding. One nanny stood almost over her young as the eagle circled and swooped within 25 feet of her. As the eagle made each swoop at close range the nanny would feign passes at it with her head. On one swoop to within a few feet of the goats the eagle landed on a small pinnacle of rock about ten feet from the nanny and kid. The nanny made a lunge at the eagle. Then she got about halfway between it and her kid the bird hopped from its perch and glided across the nanny, picked up the kid and continued gliding out beyond the cliffs. The kid hung helplessly from the talons of the bird as it sailed in a big circle, gradually losing altitude. The bird finally disappeared about a third of a mile away and appeared to be just ready to land. The eagle never flapped its wings from the time it picked up the kid until it disappeared. The inaccessability of the cliffs prevented following the eagle. The mother goat spent several minutes apparently searching up and down the slope for her young. The yearling had been feeding about 150 feet above and came running down to the nanny but she drove it away. After fifteen minutes the nanny was again feeding. The yearling was about 100 feet away. The kid that was carried away was believed to be only two or three days old and probably weighed between seven and nine pounds."

Parasites and Diseases

The carcass of the aged nanny found in the Rattlesnake in the winter of 1947-48 was completely autopsied. All the teeth were present but well-worn. A space between two upper molars had lead to infection beneath a compaction of vegetative material. Pneumonia was present in a part of the lungs but was not considered in an advanced stage. The liver, heart, kidneys and brain appeared healthy. Three tapeworm cysticerci (Taenia sp.) were found in the pleural cavity. One was free and the other two were attached to the diaphragm. There was no food material in the intestines, nor were there parasites. An impaction had stopped the passage of food from the stomach.

An adult male that died one spring while being transplanted was found to have pasteurellosis and coccidiosis infections within the lungs and caecum. Another male estimated at two years of age that died a few days later showed no indication of the presence of the sporozoan forms. Both animals were covered with a large number of ticks (Dermacentor andersoni), especially around the neck and inguinal regions. Both animals were thin and in poor condition.

Ticks were the only ectoparasites evident on all other goats handled during live trapping. Heavy occurrence of this parasite in the spring may aggravate the poor condition of animals following hard winters. It may have contributed directly to death at times.

Accidents

One of five animals found dead in the Red Butte area during the spring of 1948 appeared to have been killed in a snowslide. This animal was found in the wood and debris of a snowslide. Numerous snowslides occur all through goat habitat in Western Montana. They no doubt have accounted for a number of goat losses each year.

On some occasions goats have been seen walking on remnants of snow cornices. Many of these cornices break off quite suddenly and fall for some distance down the mountain. If a goat were out on the cornice at the time it would have little chance for escape. It is probable that some goats were lost in this manner.

It is doubtful that goats ever fall off ledges that are free of snow and ice. However, small flows of water among cliffs during late winter and early spring often form massive ice structures. Such structures seem impossible to traverse by goats or any other living creature. It is probable that once in a while a goat may get on the edge of one of these ice flows and slip to its death below. Evidence indicated that this happened in the case of the nanny found dead in the Rattlesnake (Figure 20).

One kid about two months old with an injured front leg was seen in the Red Butte area during the study of 1947. It was unable to use this leg for more than a month. The kind or cause of the injury could not be determined.

Occasionally an animal was found which had an old injury to one digit of a hoof. Such injury resulted in the digit turning outward or forward so the use was on the side or back of the digit. It was most likely the result of a fracture, possibly incurred while running or jumping.

MANAGEMENT TOOLS AND TECHNIQUES

Censusing

An inventory of current numbers and their distribution is one of the fundamental management tools for big game species. There is little information available concerning systematic censusing of mountain goats. In recent years the demand for closer management of this animal has deemed some type of an inventory necessary.

The only records of numbers in Montana in past years have been those from the United States Forest Service cumulative big game reports submitted anually by Forest Rangers. Estimates submitted by that Service from 1919 through 1942 were presented above under historical data. Certain limitations in the value and use of these estimates were discussed there.

Starting in 1943, the Montana State Fish and Game Department has been making annual estimates of mountain goat numbers in Montana. They have realized the shortcomings in the techniques of making these estimates for use in management. As a part of the study being reported on here, one of the objectives was to develop standardized techniques for measuring populations and trends in populations of mountain goats. The discussion below reports the work done thus far toward fulfilling this objective.

Preliminary Study and Census

A preliminary study was needed to determine what field conditions and factors must be considered in any state-wide census program. For this reason, a study of the Continental Divide Unit was made during the summer of 1946.

There are no roads into the goat habitat of this area. All work was accomplished either on foot or horseback. In the three months of this preliminary study a total of 443 unduplicated miles on foot and 670 unduplicated miles on horseback were traveled.

An itinerary route of travel was mapped out ahead of time. This was designed to give the observers a progressive cover of all goat habitat so all areas could be inventoried for goats and goat sign.

The area covered was vast and the allotted time short. Not more than two days, and usually only one, could be spent in any one locality. Of course, all the animals were not seen. However, observation techniques were developed which would give the observer an idea of the number of animals to estimate for each locality in addition to those seen. These techniques were standardized as much as possible so that results between observers and between areas would be comparable.

One might imagine that white animals would be quite easy to see. When they were feeding on an open grassy slope this was true. When basking on a sunny rocky exposure or loafing among the ledges, it is surprising how they resembled the many white and cream colored boulders surrounding them. The observer must learn and gain experience as to just what to look for and where to look. For general census work either 6 X 30 or 8 X 30 binoculars were indispensable. More detailed study was accomplished with the aid of a 20-power

spotting scope.

Upon visitng each area the observer would note the indicators and conditions to judge what part of the local herd was probably seen. The estimate of additional numbers to those seen would be a correlation of the size of the area, portion which could be seen, density of tracks, pellets and hair, use of forage and information obtained from men who were well acquainted with the fauna of the area. In most instances when it was possible to check the accuracy of the estimates made by observers in this study there seemed a tendency for underestimating actual numbers.

Early in the survey it was apparent that in the early morning and late evening goats were moving around in the open where they could be observed much easier. Schedules were therefore arranged so that as often as possible the observers would climb from the base camp in the morning, arrive in goat territory soon after noon and look over the country until late evening. Overnight camp would be made close to goat habitat. Observations could be resumed early the following morning. The men would then return to the progressively-moving base camp in lower country that evening.

Tabulations made of the time of day when animals were observed and their activities at the time are summarized in Table 24. Early morning results recorded here do not indicate all the animals seen at that time as most of those seen were known or believed to be the same individuals as seen and recorded the previous evening.

TABLE 24

TIME OF DAY MOUNTAIN GOATS WERE FIRST OBSERVED AND THEIR ACTIVITY
(Flathead-Sun River, 1946)

Hour	Bedded Down	Traveling or Climbing	Feeding	Loafing	Other	Total
Daylight to 9 A. M.	5	9	5			19
9 A. M. to Noon	5	19	31		1 dusting	56
Noon to 4 P. M.	16	24	72	2		114
4 P. M. to Dark	23	47	75	2	1 drinking	148
Total	49	99	183	4	2	337

Following the suggestion of Glacier National Park rangers, we also found that just following a rainstorm lasting a day or more, goats literally blossom out into the open to feed or bask in the sun. If the observer could place himself in position to command a wide view of mountain goat habitat just following such a storm a more complete check of goat numbers was possible.

For general census work, the distance from which the animals were observed

was important. To be within a close range assured the observer of a more complete coverage of a locality. It also gave opportunity for more detailed observations for identification. The distances from which goats were observed during the preliminary study of the Continental Divide Unit are listed in Table 25.

TABLE 25

DISTANCE FROM WHICH MOUNTAIN GOATS WERE FIRST OBSERVED

Distance (in miles)	Number of Goats Observed
0 - 1/8	92
1/8	2
1/4	59
1/2	58
3/4	18
1	56
1 1/2	23
2	11
2 1/2	7
3 - 3 1/2	11
Total	337

Most observations were made at a mile or less. Identification and study of characteristics were not possible at this range however. Only in case of a nanny and kid together could the age or sex be certain for over a half a mile. Too often it was difficult at far less than that distance. Whenever possible, the observers tried to approach closer to the animals for more detailed observations. At times it was easy to approach to within close range by stalking, although success in doing so could not always be predicted. Approaching the animal along the contour level was usually the most successful. Approaching from above was also often successful. Invariably, approaching from below would cause immediate alarm to the animal. A military camouflage suit was used quite successfully at times.

On such a scale a coverage such as this preliminary study of a single area for an original investigation of an area might be justified. The man power and expenses involved would not justify such intensive periodic checks needed for management on all Montana goat ranges on this intensive scale. A simpler method of checking trends in numbers and distribution must be used which will give results accurate to within the latitudes of management control.

In Montana three methods were tried for their value in making trend checks. These were spot rechecks within key management areas, aerial observations of either limited areas or entire ranges, and contacting men who spend much time in the goat ranges and whose reports seemed reliable and consistent. The success of these methods was not clearly defined at this early stage. It appeared that all types would have to be depended upon to some degree. Local conditions may make one method more workable than another or may require coordination of some or all of the methods.

Ground Rechecks of Key Areas

Spot ground rechecks were started in the summer of 1948 in four areas considered key areas of the Continental Divide Unit. The value of these checks for this first year was not satisfactory for management application, but through experience factors were recognized which will help to better further work in selecting and rechecking key areas.

Many considerations are important in selecting locations for rechecks. The areas must be strategically located so they will represent the biological and management aspects of the surrounding country. Goats must occur in sufficient numbers to apparently constitute a huntable herd or be of value as a feeder group to a huntable herd. The area must furnish an environment in which most of the animals in the area can be observed each year under optimum field conditions and give results which are comparable from year to year.

Standards of observation procedure are necessary to make each year's records comparable with another. The season of the year, period of day, length of time spent in an area, locations of observation points and methods of covering the area are all important. Local conditions would regulate these procedures.

During the spring soon after the kidding period and again in late fall just preceding and during the rut goats were usually grouped more than during the remainder of the year. Trend checks should be made during one of these two seasons. Spring is preferable as the remaining huntable herd can be measured following winter losses. Continuity of the season of observation should persist for any area.

As was pointed out in the preliminary study findings, late evening or early morning observations were most successful for determing numbers.

Experience in each area is the only background for designating the best method of obtaining complete coverage of an area. It may take a few years before the best method is found for obtaining a complete coverage of some areas. Experience in an area is the only background for designating the best points from which to make observations, the routes of travel through an area and the optimum period of time to be spent in each area. Past field experience has indicated that it is the exception if observations for only one day are sufficient for any area.

Aerial Censusing

In many areas ground rechecks are not feasible. In some others they are questionable. In some such areas Montana has started to census mountain goats from the air. Results thus far in the use of the airplane have been highly encouraging. By plane large expanses of goat country can be well covered in a comparatively short time. This is an important advantage in the census of any big game species.

The most extensive aerial work done thus far has been the observation of the Bitterroot goat herd. In nine and a quarter hours of flying most all

the goat range in [illegible] area was covered. This was figured to be comparable with 40 to 60 days of ground work for a two-man crew and three horses.

Mountain experience of the pilot and the right type of plane is of prime importance in this work. A 250 horsepower, 4-place air sedan was found to be very maneuverable with sufficient power for the necessary climbing and turning in close mountain quarters. If the same amount of power can be maintained but the air speed cut to less than 70 miles per hour longer observations and better use of binoculars would be possible.

Experience gained from ground observations was valuable help in the air reconnaissance but additional special techniques were obviously needed. Seasonal concentrations of goats were still to be considered to get the best counts. Daily concentrations were also important, although air conditions for flying made morning the most desirable. The first three hours of daylight provided the smoothest air for close mountain flying. It also found the goats still fairly well-grouped from the previous night.

When the use of planes has been fully developed for goat censusing, it is believed that trend checks will be feasible over entire units of goat range. This will do away with the use of key or representative areas.

Development of aerial censusing will require standardized flight and observation procedures which will make each year's count comparable with the others. Flight patterns of routes and elevations must be worked out for each individual area. This requires a thorough familiarity with topographic features by both the pilot and chief observer.

The use of the plane for making a count of the Bitterroot goats proved satisfactory. It is expected that within a short time this method of censusing mountain goats will be the most practical and widely used.

Special Personal Reports

In the past the numbers of goats and their distribution have been estimates of Forest Rangers as submitted in their annual cumulative big game reports. The Rangers' duties are of such a nature that they are seldom able to carry on detailed censusing of big game species, especially of mountain goats. Their reports are based on their experience in the area and the irregular observations made while on other routine duty. Such estimates are not meant to be comparable to a comprehensive and detailed census. But the experience, sincere interest and cooperation of most Rangers have contributed a wealth of information as background for the work carried on in this study. Additional information of the same type was also derived from deputy game wardens, packers, guides and old-time resident hunters.

The usefulness of this type of data has not been limited so much by the integrity of the individual reports as it has by the lack of a correct correlation of all reports. The amount of duplication, the inference of each observation and the accuracy of each report must be judged in some way. There are no exact measures for making this judgement . Individuals collecting and correlating the information must be men of experience and ability. Their personal judgement in these matters must be reliable.

In the future it is hoped that specially trained personnel may obtain up-to-date herd condition and trend information which will be applicable to good detailed management. Any method they use will never be mechanically perfected. There will probably always be a need for observations and reports from competent outside men who have continued experience in mountain goat country.

Live Trapping and Transplanting

Most all the native goat range in Montana is closely associated with the Continental Divide. Indications are that these are the historical ranges, materially unchanged by civilization. The small amount of natural expansion of mountain goat range has been localized in extent and it is doubtful if it would ever expand naturally to the more isolated uninhabited ranges.

In 1941, a program for expanding mountain goat domain was started. Live trapping animals from larger herds and transplanting them into uninhabited portions of favorable habitat was the objective. Trapping operations have been carried on each year, except 1944, and has produced 62 goats for transplanting to new areas. Table 26 gives the locations and kinds of transplants made. Previous discussion under "range and distribution in Montana" describes their known degree of success in establishing herds.

The latest transplant listed was in partial fulfillment of a trade with the Colorado State Game and Fish Department for sixteen bighorn sheep from their successful Tarryall herd. The balance of seven goats should be sent to Colorado by the time this report is completed.

TABLE 26

MOUNTAIN GOATS LIVE TRAPPED AND TRANSPLANTED IN MONTANA

Date	Male		Female		Total	Cumulative	Where Transplanted
	Mature	Young	Mature	Young			
April, 1941	3	1	5	1	10		Crazy Mts. Sweetgrass Canyon
		2			2	12	Benchmark, Sun River
April 5, 1942	2	1	7	2	12	24	Beartooth Plateau, Lake Fork of Rock Creek
April 5, 1943	4		6	1	11		Crazy Mts. Sweetgrass Canyon
		1	1	2	4	39	Highwood Mountains
May, 1945	2				2	41	Beartooth Plateau, Stillwater Canyon
August, 1946	3		3	1	7	48	Beartooth Plateau, Stillwater Canyon
May, 1947	2	1	2		5	53	Gallatin River, Spanish Peaks
May, 1948	6		3		9	62	Sharamo Mountain, Colo.

Trapping Methods

All goats captured through 1948 have been taken from the Teton drainage west of Choteau, Montana. A salt-baited pen-type trap was used. This has been the most successful method of trapping so far. It is limited, however, by the weather conditions and the time of year which makes it possible to bait the goats with salt.

Location of trapping sites for the pen-type trap required careful consideration. Accessibility of the locality, distance from trap to motorized transportation and the goat numbers likely to be attracted to the salt were a few of the criteria.

One of the pen-type traps which has been operated successfully is shown in Figure 22.

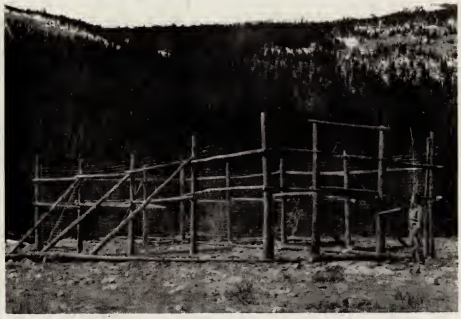


Figure 22

Pen-type Trap for Capturing Mountain Goats

This pen was about 12 x 16 feet (this may be varied a great deal according to needs) and 8 feet high. The gate was four feet high and five feet wide. It could be tripped automatically or manually. The entire pen was constructed of a strong framework of poles covered by heavy woven-wire fencing.

There are many native herds from which a surplus of perhaps two to five animals could be harvested each year. This would require methods and facilities which are economically feasible for taking small numbers. Pen-type traps and the necessary personnel to operate them are too impractical in some areas. Some means of trail-trapping on the summer range would be better. This necessitates lightweight trapping and transporting devices which are

easily moved by foot or horseback in mountainous terrain.

Experimenting has been done and is being continued by the Montana State Fish and Game Department to find practical devices suited for back country live trapping and transplanting. Observations indicated that a goat could be made to step into almost any trap if properly placed in a well-used trail. This led to trial use of the following techniques with experimentation toward further refinements.

A number 4½ Newhouse steel trap was used with wrapped jaws. The wrapping was made with two overlap wraps of rubber electricians' tape and two wrappings of black friction tape. The traps were buried and carefully concealed on a trail. The holding chain was secured by a swivel to a nearby tree or log. Drift barricades were constructed of deadwood which would divert the animals over the trap. It was easy to get a goat to step into this trap but they would pull out of the jaws if they were heavily wrapped. A leg injury resulted if the jaws were lightly wrapped. At least certain modifications would be necessary before this method could be successfully adopted.

Another leg trap used experimentally was tripped by a pan and throws two half hitches of chain around the animal's leg. The chain is freed of the trap and leaves the animal tethered by one foot to some kind of anchorage. The spring in the original trap was found to be too slow to catch a goat's leg. A revision of the trap holds considerable promise.

Several types of snares have been tried. One was a variation of the regular trapper's snare. It is set with a spring tree and adjusted to catch the animal around the body, just behind the front legs. It takes an experienced trapper to properly adjust the delicate tripping mechanism. However, once this is learned a small crew of men would find it quite handy to carry several traps in a knapsack. The resultant injury to goats was too great with this particular type though. This technique has been discarded until revisions are made to correct the fault.

Two net traps hold a great deal of promise for future operations. One type was constructed of a circular piece of netting eight feet in diameter having an 8-inch mesh. The outer edge was bound to a half-inch rope with metal rings at intervals all the way around. It was laid on a well-used trail and covered shallowly with duff. A rope was threaded through the metal ring guides and tied to a spring tree. The tree was pulled down and held with a hair-wire trip. When an animal broke the trip the tree sprang erect. and enclosed the animal in the netting.

Another version of this trap required two trees and lifted the animal off the ground with its feet through the netting. It differed in that the net did not enclose the animal but merely made it helpless by lifting it across the abdomen so its feet did not touch the ground.

Handling and Transporting

Once the animals were captured skill was required to successfully transport them to points of release. Whenever possible, motorized transportation was used from the traps to points of release. Since the war, the introduction of the jeep and power wagon has reduced accessibility problems in

Figure 23

Mountain goat in the pen-type trap.

many areas. In more remote areas horses, man packs, boats and airplanes are being used successfully.

Individual carrying equipment for transporting captured animals varied with terrain, mode of travel and individual circumstances. When foot travel was necessary a special canvas was designed which could be used as a knapsack and then unrolled and laced between two poles to form a stretcher or a travois. This same canvas could be used as a sling to lower animals over ledges. Using it as a travois and strapping the animal to it made transporting over cliffs much easier.

Kid goats and sometimes yearlings could be carried for some distance in a knapsack. With some adult animals it was possible to secure a rope to each horn and let them walk out under strict guidance if the distance was short.

For conveying animals out of back country by pack horse, wooden crates were first used. The additional weight and bulk of the crates made transporting too bunglesome on most mountain trails. Special panniers have been constructed of canvas with four leg-holes and a head-hole. A goat could be strapped into a pannier and one slung on each side of a pack horse. Recently a pack cage has been constructed of aluminum tubing and covered with canvas lacing. These are easier to pack on a horse and can be used on a truck for the entire trip of an animal if necessary.

As might be suspected of any wild animal, confinement and handling by humans resulted in severe nervous shock to the animal. This was oftentimes fatal. Moving mountain goats out from the back country and transporting them into similar back country habitat necessitated a great deal of handling. Techniques and experience have cut this handling to a minimum. It was found that the use of special canvas blindfolds on the goats from the time they were caught until released would reduce nervous shock. It also rendered animals much easier to handle. Captive animals without blindfolds could seldom be induced to eat a thing offered them. A blindfolded animal would readily eat from a man's hand practically anything offered it, from alfalfa hay to plain snow. Sodium penta barbital injections have been successfully administered to some goats to quiet them during handling.

Care must be exercised in protection of the men handling these animals. The dagger-like horns of adult goats must always be respected. Large males were especially dangerous. They often lashed out viciously at other animals while confined in a pen. Often this removed streaks of hide and in one instance a goat was punctured through the abdomen and lung. The same could happen to men handling them if they did not take precautions. Animals loose in a pen were caught by roping. After securing with a rope, control of the larger animals was best obtained by getting a good hand-hold on the animal's chin whiskers. An attempt to take hold of a horn could result in a punctured hand. The slashing uppercut movement of an animal's head was extremely fast and dangerous. After the animal was thrown on his side it usually became completely passive to most all handling. For protection from the horns, the ends of a short piece of rubber garden hose was slipped over the points of the horns so as to form a loop from one horn to the other.

A note of interest was the lunging performance of the goat when accosted

in close quarters. When in crates during transportation the animals made short and abrupt lunges toward spectators. The suddenness always startled the observer but the animal never hit the end of the crate. In the pen traps a goat seldom hit the side of the trap more than once in an attempt for freedom. After hitting the side once other passes climaxed in a lunge and sudden stop a foot or two from the wire.

Harvesting

Montana has been taking some mountain goats as legal hunter harvest. The seasons, areas and numbers known to have been taken by hunters to date are listed in Table 27.

Past records indicate that the Bitterroot herd decreased from an estimated 1,000 animals in 1925 to about 315 in 1947. It is believed that this herd suffered a heavy natural loss regardless of the hunting pressure. The added hunting pressure aided in diminishing the base herd for the area. It has decreased so seriously that the area was closed to hunting in 1948. It is hoped that this protection will allow the herd to rebuild to former numbers.

The Flathead herd, on the other hand, has shown signs of increasing in numbers at times. At least the number has not gone downward, yet it has supplied from 25 to 75 animals a year to hunters. The base herd here is larger than the one in the Bitterroots and there is a great deal more yearlong range. Also, the entire area inhabited by goats has not been open to hunting. There are many important groups closely associated with the open area. These act as feeder groups to the hunted herd. Such feeder groups occur along the Sun River and Teton River headwaters on the east side of the Continental Divide. On the west side of the Divide the headwaters of Monture Creek of the Blackfoot, the Clearwater and Swan River side of the Swan range and the area between Little Salmon and Big Salmon Creeks in the South Fork of the Flathead support feeder herds. The boundaries of the open area were described with this feeder system in mind. It was felt that this system was good management and that it would contribute to the success of hunting in the Flathead. The Flathead is probably the only area in the State where regular open seasons are practicable at the present time.

In many areas a limited and controlled number of animals might be harvested and still maintain current numbers. The take may amount to only two or three animals per year in some cases. Without the legal hunting control necessary to insure removal of only the desired number of goats, though, such areas are permanently closed to hunting. The State Fish and Game Department is now trying to make use of these small increments by live trapping only a few goats from each of several areas for the purpose of transplanting to new areas.

TABLE 27

MOUNTAIN GOAT HUNTING SEASONS AND KILLS IN MONTANA

Year	Bitterroot Dates (inclusive)	Kill	Flathead Dates (inclusive)	Kill	Total Kill
1905	Entire state open Sept. 1 to Dec. 1 for 1 goat of either sex per hunter				
1924	Unknown	20	Unknown		20
1925	"	20	"		20
1926	"	10	"		10
1927	"	10	"		10
1928	"	10	"		10
1929	Nov. 6 - Nov. 15	19	"		19
1930	Oct. 15 - Nov. 15	18	"		18
1931	Oct. 15 - Nov. 15	25	"		25
1932	Oct. 15 - Nov. 15	33	"		33
1933	Sept. 20 - Oct. 20	29	"		29
1934	Sept. 20 - Oct. 20	19	"		19
1935	Sept. 20 - Oct. 20 (males only)	11	Sept. 20 - Oct. 20 (males only)	Unknown	Unknown
1936	Sept. 20 - Oct. 20	9	Oct. 15 - Nov. 15	34	43
1937	Sept. 20 - Oct. 20	9	Oct. 15 - Nov. 15	55	64
1938	Sept. 20 - Oct. 20	25	Oct. 15 - Nov. 15	23	48
1939	Sept. 20 - Oct. 20	20	Oct. 1 - Oct. 30	50	70
1940	Sept. 20 - Oct. 20	19	Oct. 1 - Oct. 30	79	98
1941	Oct. 11 - Oct. 20	20	Sept. 15 - 19 and Oct. 15 - 19	70	90
1942	Oct. 11 - Oct. 20	17	Sept. 15 - 19 and Oct. 15 - 19	44	61
1943	Oct. 11 - Oct. 20	Unknown	Sept. 15 - 19 and Oct. 15 - 19	44	Unknown
1944	Sept. 20 - Oct. 20	42	Sept. 15 - 19 and Oct. 15 - 19	62	104
1945	Oct. 1 - Oct. 31	39	No season		39
1946	Oct. 1 - Oct. 31	28	No season		28
1947	Oct. 1 - Oct. 31	80	Sept. 15 - 19 and Oct. 15 - 19	34	114
1948	None		Oct. 1 - 5 and Oct. 15 - 19	40	40

SUMMARY

1. This study has been designed to present an inventory of numbers, life history data and management practices known to date, which will serve as a basis for developing the standard of management of mountain goats desirable in the future.

2. Native mountain goat habitat in Montana is within the more rugged and isolated terrain along or near the Continental Divide in Western Montana. This range has been expanded some by a live trapping and transplanting program in this state.

3. A preliminary study was conducted in the Continental Divide area of the Flathead and Sun River drainages which disclosed important information on distribution and numbers of goats. Most goats occurred above 6,750 feet elevation, in alpine openings where forage was abundant and usually within steep or cliffy surroundings.

4. Information about distinguishing body characteristics is presented from 29 animals. Little difference was noted between body sizes of the two sexes until the animals were almost mature. Then, male goats usually became five to ten per cent larger than females. The average weight of the adult goats taken was 135 pounds.

5. An analysis of the dentition found in these goats indicates that goats have three pair of milk incisors in the lower jaw and three pair of milk premolars in both jaws at birth. By nine months there was an additional pair of milk incisors and one pair of permanent molars in both jaws. At seventeen months the inner pair of incisors was replaced by permanent incisors and the second pair of molars was present in both jaws. When the animal was 33 months old the second pair of incisors and two pairs of premolars were replaced by permanents. Within the next two or three months, the third pair of premolars was replaced and the third pair of molars came in. They got their third set of incisors between the ages of three and four years and their fourth set after they were four years old.

6. The horns of a mature mountain goat averaged between eight and a half and nine and a half inches long. They were bovine in structure being hollow caps on persistent bony cores. The horns are never shed.

7. Goats shed their pelage once each year. The time and duration of shedding varied with the animals.

8. The keenest sense of mountain goats was apparently sight, especially for movements.

9. Mountain goats usually had only one young at a time, born the last of May or the first part of June after a gestation period of about six months.

10. Just preceding, during and for a short time after parturition, female goats stayed mostly to themselves. Later they banded with other animals at night and later in the summer they traveled most of the time in groups. They usually stayed grouped during the winter.

11. Some high mountain goat summer ranges were used during the winter if wind action made feed available. In many cases winter feed was not available on the summer range and the goats migrated to lower south exposures each fall.

12. In the study of food habits, the relative availability of forage species and their relative use preference determined the relative importance of those species in the diet of animals using that range.

13. The dwarf huckleberry (Vaccinium scoparium) was the outstanding food of mountain goats on the summer range studied.

14. Cured grasses, junegrass (Koeleria cristata) and bluebunch wheatgrass (Agropyron spicatum), were the important forage species on both winter ranges studied. Browse species, serviceberry (Amelanchier alnifolia) and willow (Salix sp.), were of secondary importance.

15. Water was not believed to be important in the distribution of mountain goats in Montana.

16. Mountain goats exhibited a strong desire for the contents of artificial and natural mineral licks. They were attracted to them from early May to about the first of August.

17. Numbers and the distribution of mountain goats has not altered much during the period of years for which there are records.

18. In 1947 there was estimated to be 4,451 mountain goats in Montana.

19. Most natural losses of mountain goats occurred in winter. Susceptability to predators, parasites, diseases and accidents seemed enhanced by adverse winter weather elements.

20. Eagles were probably the most important predators. Several cases of eagles preying on or attempting to prey on goats were known. Coyotes, bears, mountain lions and wolverines also lived in mountain goat habitat of Montana. Their importance as predators on goats is not yet well understood.

21. Aerial censusing of mountain goats is probably the most practical census technique for use in management.

22. From 1941 through 1948, sixty-two mountain goats were live trapped and transplanted to uninhabited mountain goat ranges. The plant made in the Crazy Mountains has successfully established a new herd.

23. Limited hunting seasons on mountain goats have been allowed in the Bitterroots and in the Flathead. The Bitterroot herd has apparently suffered from the hunting pressure so that area was closed in 1948. The hunter take from the Flathead has not been detrimental to that herd. Feeder groups of animals outside the hunting area has helped replace the goats taken by hunters.

24. Legal authority to confine hunter take to a definite number would make it possible to harvest a limited number of mountain goats from several other areas. Herds in those areas cannot withstand a general open hunting season.

RECOMMENDATIONS FOR MANAGEMENT

1. Evidence obtained during this study indicates the danger of hunting mountain goats without control. It is therefore urged that legislators be requested to consider the possibility of passing laws which would allow an annual harvest of mountain goats on a limited permit basis, with reports required by all permit holders.

2. Uncontrolled hunting of mountain goats should not be allowed in any areas of the State with the exception of the following described area, wherein a ten-day season should not prove detrimental due to the isolation of the area and a strategically located closed area.

Mountain Goat Hunting Area

Continental Unit

LIMIT: One (1) adult goat per person per season.

OPEN AREA: An area beginning near Java Guard Station at the point where the Great Northern Railway track crosses the Middle Fork of the Flathead River, thence up the Middle Fork River to the mouth of Long Creek, thence up Long Creek to the divide at Twin Peak, thence along the divide in an easterly direction to Horseshoe Peak, thence in a southeasterly direction along the divide to Gunsight Peak, thence in an easterly direction along the ridge north of Dean Creek to Pentagon Mountain, thence in a southerly direction down the East Fork of Pentagon Creek, thence down pentagon Creek to its confluence with Spotted Bear River to the mouth of Wall Creek, thence up Wall Creek to the Divide between Wall Creek and White River, thence in a westerly direction along the Divide to Silver Tip Mountain, thence down Mid Creek in a westerly direction to its confluence with the South Fork of the Flathead River, thence in a northerly direction down the South Fork of the Flathead River to its confluence with Gorge Creek, thence in a westerly direction up Gorge Creek to Bunker Creek, thence up Bunker Creek to Thunder Bolt Mountain, thence in a southerly direction along the divide between the headwaters of the South Fork of the Flathead Drainage and the Swan River, known as the Swan Divide, to Holland Peak, thence along the Divide to Crescent Mountain, thence in an easterly direction following the watershed to the Continental Divide at Triple Divide, thence in a northerly direction along the Continental Divide to Marias Pass at Summit, Montana, thence along the Great Northern Railroad track in a westerly direction to the point of beginning.

3. A periodical census of mountain goats should be made in the more important herd units, particularly where hunting is permitted. Special consideration should be given the possibility of using and improving aerial trend counts.

4. Further study is needed to determine the limiting factors in goat populations and to direct management toward increasing the various goat

herds to the point where an annual controlled harvest is possible.

5. Field study of mountain goats is very difficult and much of the desired information can be obtained only under controlled conditions. It is, therefore, suggested that a family unit of goats be enclosed and studied. Particular emphasis should be placed on nutritional requirements, breeding characteristics and possible limiting factors. A suitable area should closely resemble natural habitat and be of sufficient size to reduce as much as possible any artificiality.

6. Expansion of goat transplanting should proceed as rapidly as possible and all suitable range should be stocked. Present indications are that introductions will be most successful if at least 20 animals are released at selected sites. Surplus animals are available in the South Fork of the Flathead, Deep Creek, and it is believed the Crazy Mountains herd now has surplus animals. Previous releases in the Beartooth Plateau and Gallatin River should be supplemented before new plants are made.

7. One herd should be selected for direct management including predator control, controlled harvest and study of migration of tagged animals. Special emphasis should be placed on determining the population level at which an optimum harvest can be taken and yet maintain herd numbers.

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